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STUDIES IN THE APOCYNACEAE. I[1]

A Critical Study of the Apocynoideae

(With Special Reference to the Genus Apocynum)

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[1] An investigation carried out at the Missouri Botanical Garden in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University, and submitted as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy in the Henry Shaw School of Botany of Washington University.

Issued May 14, 1930.

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1. The Status of the Apocynoideae

INTRODUCTION

Somewhat less than four years ago, when the writer commenced a revision of the genus *Apocynum*, the possibility of further studies in the family Apocynaceae was reserved for the future. However, it soon became apparent, as the study progressed, that the problem was so complicated and had been neglected so long that it could be dealt with satisfactorily only in intimate conjunction with a thorough investigation and readjustment of the entire family. The situation was complicated, moreover, not only with numerous Apocynaceae, but with Asclepiadaceae as well.

A glance at the synonymy of *Apocynum*, for instance, will show that that genus alone has been entangled with no less than thirteen genera of Apocynaceae, and, even more surprising, twenty-two genera of Asclepiadaceae. Observation of other genera of Apocynaceae has shown that the situation of *Apocynum* is representative of the group as a whole. With such conspicuous need of an extensive revision, the present study has been prepared as the forerunner of a group of similar papers which will be concerned with the comparative morphology, taxonomy, distribution, and system of Apocynaceae, and, it is hoped, later of Asclepiadaceae as well.

SYSTEMATIC HISTORY OF THE APOCYNACEAE

Previous to Tournefort, practically all of the plants then known which are now distributed between the families Apocynaceae and Asclepiadaceae were included in one monstrous group *Apocynum*, a Latinized form of a name of Dioscorides, 'Απόκυνον, applied to a plant of Greece used as a poison for wild dogs and other animal pests. This plant, according to Dioscorides, was distinguished above all by its milky juice, and consequently any plant which happened to yield latex was apt to be named *Apocynum*,

first by the followers of Pliny, who evidently deserves credit for the composition of the name, and later by the disciples of the revered physician Galen. One generic name, therefore, characterized multitudes of pre-Tournefortian polynomials applied to milk-yielding plants which were indiscriminately Euphorbiaceae, Asclepiadaceae, or Apocynaceae.

By the time of Tournefort, students of botany had become sufficiently keen-sighted to eliminate the various Euphorbiaceae (chiefly species of *Euphorbia*) from the *melée* which was the genus *Apocynum*, but most of the genera then known, which are now understood to be Apocynaceae or Asclepiadaceae, were yet included under that single name.

The generic splitting of *Apocynum* began with Tournefort,[2] who recognized three generic entities in the old group. These genera, *Apocynum*, *Periploca*, and *Asclepias*, were deftly distinguished both verbally and pictorially and heralded the distinction of the families Apocineae and Asclepiadeae which was to be made by Robert Brown over one hundred years later after the prestige of the artificial system of Linnaeus had been overthrown by Jussieu and his contemporary naturalists. Seven other genera now placed among the Apocynaceae were also recognized by Tournefort, which, however, were not understood by him to have any direct affinity with *Apocynum*. These genera are *Rauvolfia*, *Cerbera*, *Vinca*, *Nerium*, *Plumeria*, *Cameraria* and *Tabernaemontana*.

The sexual system of Linnaeus proved artificial indeed in the manner with which it treated the genera of Apocynaceae and Asclepiadaceae. The 'Genera Plantarum'[3] split the aggregate of the two families between the "pentandria monogynia," including the genera *Rauvolfia*, *Cerbera*, *Vinca*, *Nerium*, *Plumeria*, *Cameraria*, and *Tabernaemontana* of Apocynaceae and *Ceropegia* of Asclepiadaceae, and the "pentandria digynia," including the genera *Periploca*, *Cynanchum*, *Asclepias*, and *Stapelia* of Asclepiadaceae and the genus *Apocynum* of Apocynaceae.

The natural system of Jussieu[4] proved its worth by the man-

[2] Tourn. Inst. ed. 2, 2: 91–94. 1700.
[3] Linnaeus, Gen. Pl. ed. 5, 98–102. 1754.
[4] Juss. Gen. Pl. 143–151. 1789.

ner in which the Apocynaceous and Asclepiadaceous genera were treated. Those present families were combined in the class Apocineae, and were divided into three unnamed divisions upon fruiting characters. The first division embraced genera producing a pair of follicles separating at maturity, the seeds naked; the second, genera with two distinct follicles and comose seeds; and the third, genera with follicles united at maturity in the form of a berry or drupe. Appended to those three divisions was a fourth, consisting of several anomalous genera demonstrating an affinity with the Apocineae proper, but without latex. Those genera were *Strychnos*, *Theophrastia*, *Anasser*, *Fagraea*, and *Gelsemium*, all of which are extraneous to either Apocynaceae or Asclepiadaceae as at present understood.

The sagacity of Robert Brown in his separation of the Asclepiadaceae from the Apocynaceae can scarcely be overrated. In his two classic papers 'On the Asclepiadeae'[5] and 'On the Apocineae'[6] which were read before the Wernerian Society, November 4, 1809, the individuality of the two great natural groups for the first time became apparent. The latter paper moreover especially concerns us as a most excellent and acute appraisal of the genera of Apocynaceae then recognized. One error, however, was the inclusion of the Asclepiad *Cryptolepis* with the Apocineae.

The name "Apocynaceae" was first applied to that family by Lindley[7] in 1836. The group of Lindley was practically identical with the "Apocineae" as defined by Brown, by whom it was clearly influenced to no small degree since several paragraphs of the latter's address before the Wernerian Society[8,9] were quoted verbatim by the former. In his synopsis of the genera of Apocynaceae, Lindley employed the subdivisions of Bartling,[10] who recognized within the family three divisions, namely: *Echitea*, genera with distinct, capsular, polyspermous follicles and seeds with little albumen; *Carissea*, genera with follicles connivent at maturity into a polyspermous berry and seeds with copious albu-

[5] R. Br. Mem. Wern. Soc. 1: 12–58. 1809.
[6] *l. c.* 59–78. 1809.
[7] Lindl. Nat. Syst. ed. 2. 299–304. 1836.
[8] R. Br. Mem. Wern. Soc. 1: 12–58. 1809.
[9] *l. c.* 59–78. 1809.
[10] Bartl. Ord. Nat. Pl. 203–205. 1830.

men; and *Rauwolfea,* genera with follicles connivent into a bi- or mono-spermous drupe at maturity and seeds with little albumen.

The system of Endlicher[11] divided the Apocynaceae into three tribes and four subtribes. These divisions were enunciated as follows: *Carisseae:* ovary simple, bilocular or unilocular, fruit baccate, or rarely capsular; *Ophioxyleae:* ovary double, fruit drupaceous; and *Euapocyneae:* ovary double, fruit bifollicular, occasionally pulpy. Under the last tribe, there were four subtribes as follows: *Plumerieae:* seeds ecomose, peltate; *Alstonieae:* seeds peltate, ciliate-comose; *Echiteae:* seeds basally comose; and *Wrighteae:* seeds apically comose. This system was accepted by Spach[12] and others.

Alphonse de Candolle[13], in accepting Lindley's family Apocynaceae, redistributed the genera into original tribes much resembling those into which they are at present found. The family as a whole was defined almost exactly as Brown had outlined it in 1809. The seven tribes recognized by de Candolle are as follows: Tribe I. *Willughbeiae:* ovary simple, unilocular, two placentae, ovules amphitropous, seeds naked, calyx eglandular; Tribe II. *Carisseae:* ovary simple, ovules amphitropous, fruit a drupe or a berry, seeds naked, calyx eglandular; Tribe III. *Plumerieae:* ovary double, ovules amphitropous, fruit a drupe, a berry, or a true follicle, seeds naked; Tribe IV. *Parsonsieae:* ovary single, bilocular, seeds apically comose, cotyledons convolute; Tribe V. *Wrightieae:* ovary double, ovules amphitropous, follicles two, seeds basally comose; Tribe VI. *Alstonieae:* ovary double, ovules amphitropous, follicles two, seeds comose throughout; Tribe VII. *Echiteae:* ovary double, ovules amphitropous or occasionally anatropous, follicles two, seeds apically comose.

Mueller[14] in 1860 divided the family into six tribes: Tribe I. *Allamandeae:* anthers completely fertile, ovary single and unilocular, fruit a capsule or a drupe; Tribe II. *Carisseae:* anthers completely fertile, ovary single, uni- or bi-locular, fruit a berry or a drupe; Tribe III. *Ophioxyleae:* anthers completely fertile,

[11] Endl. Gen. Pl. 577–586. 1836–1840 (1841).
[12] Spach, Hist. Nat. Vég. 8: 499–503. 1839.
[13] A. DC. in DC. Prodr. 8: 317–489. 1844.
[14] Muell.-Arg. in Mart. Fl. Bras. 6[1]: 6–7. 1860.

ovary double, fruit drupaceous; Tribe IV. *Plumerieae:* anthers completely fertile, ovary double, fruit follicular; Tribe V. *Malouetieae:* anthers fertile only towards the apex, seeds comose over the entire surface; Tribe VI. *Echitieae:* anthers fertile only towards the apex, seeds apically comose.

In 1876 the tribes of Apocynaceae were reduced by Bentham[15] to three: *Carisseae:* including de Candolle's tribes I and II; *Plumerieae,* including de Candolle's tribes III and VI; and *Echitideae,* corresponding to de Candolle's tribes IV, V, and VII.

Miers,[16] in 1878, divided the family into an extremely elaborate system, but one that appears highly artificial and ambiguous:

"Class I. HAPLANTHEREAE: stamens each with two anther-cells, parallel, adnate, or often dorsally attached to a soft connective.

"A. Ovule and seed anatropous.

"Tribe 1. *Ophioxyleae:* fruit drupiform and indehiscent, either single or double; cells monospermous . . . .

"B. Ovule and seed heterotropous, when the hilum is on the middle of one of the faces, equidistant from the radicular and cotyledonary extremities.

"Tribe 2. *Carisseae:* fruit drupaceous, indehiscent, 2-locular, or 1-celled by abortion: seeds imbedded in pulp, . . . embryo straight, in albumen.

"Tribe 3. *Willughbeieae:* fruit drupaceous, indehiscent, 1–2-celled; seeds compressed, imbedded in pulp; embryo straight, without albumen . . . : thus differing from the preceding in the absence of albumen.

"Tribe 4. *Thevetieae:* 1 or 2 indehiscent drupes, 1- or 2-celled, cells or pseudocells monospermous; seeds without pulp, oval, fleshy, peltately affixed, exalbuminous; embryo with a short radicle.

"Tribe 5. *Hunterieae:* 1 to 5 oval dry indehiscent drupes, monospermous: seed compressed, without pulp, laterally attached by a central hilum; embryo in copious albumen, with a superior radicle.

"Tribe 6. *Aspidospermeae:* 2 follicles, rarely combined into a 2-locular fruit, or generally only 1 by abortion . . . ; seeds large, parallely adjacent, extremely compressed, broadly winged all round a central embryoniferous scutcheon . . .

"Tribe 7. *Allamandeae:* a single orbicular subcompressed dry capsule, unilocular . . . ; seeds not very numerous; testa oval, with a broad thick callous margin (instead of a wing) surrounding a flat embryoniferous scutcheon . . .

"Tribe 8. *Plumerieae:* 2 large, divaricated, thick, linear-oblong follicles, opening along their ventral suture, which expands internally into 2 flat septiform placentae: seeds many, sub-compressed, furnished below with a lacerated wing, and affixed peltately and imbricately upon each semiseptum . . .

"Tribe 9. *Alyxieae:* 2 lomentaceous flat indehiscent follicles, transversely articulated into several dry, monospermous cells . . .

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[15] Benth. in Benth. & Hook. Gen. Pl. 2: 681–728. 1876.

[16] Miers, Apoc. S. Am. 6–10. 1878.

"Tribe 10. *Craspidospermeae:* an elongated subcompressed, 2-locular capsule, resolvable into 2 follicles by the splitting of its bilamellar dissepiment . . .

"Class II. SYMPHYANTHEREAE: stamens connivent, each with 2 parallel anther-cells introrsely fixed upon a much longer horny connective, usually membranaceous or cuspidate at the apex, and terminating below in 2 longer or shorter forks, the pollen-cells adhering to the clavuncle of the style, all thus held together in a cone.

"Tribe 11. *Tabernaemontaneae:* 2 follicles, ovoid or oblong, often pointed, dehiscing along their ventral suture, whose introflexed margins are seminiferous . . .

"Tribe 12. *Malouetieae:* 2 follicles, linear, oblong, or terete, dehiscing along their ventral suture, the margins of which are thickened introrsely into a solid, resilient placenta, seminigerous on both sides . . .

"C. Seeds anatropous without an apical coma.

"Tribe 13. *Robbieae:* 2 long follicles dehiscing along their ventral suture, the margins of which expand internally into 2 septiform membranaceous placentas bearing many imbricated seeds, which are oblong, . . . generally clothed with many long, soft hairs . . .

"Tribe 14. *Odontadenieae:* 2 elongated follicles (or 1 by abortion) dehiscing along their ventral suture, the margins of which are invariably expanded into 2 broad septiform placentae . . . ; seed long, terete, erect, narrow at its two extremities, everywhere bare . . .

"D. Seeds anatropous with an apical coma.

"Class III. ECHITEAE: seeds linear oblong compressed or terete, often with an elongated rostrum terminated by the micropyle, which is surrounded by a cup-shaped ring, bearing a crown of 1 or 2 series of long hairs, usually called a COMA.

"Tribe 15. *Macrosiphonieae:* 2 very long subtorulose follicles, dehiscing along the ventral suture, the narrow margins of which are inflected and seminiferous . . . Low erect, or prostrate plants, with a few axillary handsome flowers, having an extremely long narrow tube with a broad rotate border.

"Tribe 16. *Stipecomeae:* 2 follicles with very thick pericarp, sometimes very long, rugous or verrucose, dehiscing along the ventral suture, either with 2 placentas conjoined by a keel attached to the suture and then detaching itself, or else narrower remaining separately attached to the suture . . .

"Tribe 17. *Wrightieae:* an oblong 2-celled capsule, splitting septicidally through a thick bilamellar dissepiment (becoming like 2 follicles) . . .

"Tribe 18. *Prestonieae:* an oblong 2-celled capsule, splitting septicidally, as in the preceding tribe . . . : seeds many, imbricated, oblong, furnished at the apex with a long coma, near which they are suspended . . .

"Tribe 19. *Dipladenieae:* 2 long terete follicles dehiscing along the ventral suture . . . The chief peculiarity consists in a disk of 2 flat opposite lobes alternating with the ovaries.

"Tribe 20. *Prosechiteae:* 2 oblong or terete follicles . . . disk urceolate, entire, or more often partly cleft into 5 or 10 lobes.

"Tribe 21. *Mesechiteae:* 2 long terete or torulose follicles, dehiscing along the ventral suture . . . Corolla small, or of moderate size, with a short tube, and rotate segments simply convoluted . . ."

Asa Gray,[17] in systematizing the Apocynaceae of North America in 1878, reduced the subdivisions of the family to two, namely *Plumerieae*, characterized by free stamens (unconnected with the clavuncle), the cells of the anthers polliniferous to the base; and *Echitideae*, characterized by stamens closely connivent about, and appressed to, the clavuncle or stigmatic-head; and anthers largely sterile and appendiculate, polliniferous only near the apex. In thus basing his classification, Gray plainly followed Mueller in using the stamen as the important criterion of cleavage.

In 1895 Schumann[18] raised Gray's two tribes to the rank of subfamilies, calling them *Plumeroideae* and *Echitoideae* respectively, and subdivided them into tribes as follows: Subfam. I. PLUMEROIDEAE: Tribe 1. *Arduineae:* ovary syncarpous, not divided to the base; Tribe 2. *Pleiocarpeae:* ovary divided to the base, follicles more than two; Tribe 3. *Plumiereae:* ovary syncarpous, divided to the base, follicles two; Subfam. II. ECHITOIDEAE: Tribe 1. *Echitideae:* anthers inserted within the corolla-tube; Tribe 2. *Parsonsieae:* anthers exserted beyond the corolla-tube.

Since 1895, systematic works have dealt more generally with phylogenetic speculations among groups of families rather than with the detailed system within the individual family, and in the case of the Apocynaceae, Schumann's system has remained the most recent until the present.

This historical sketch of the system of the family Apocynaceae, although incomplete and lacking in detail, is sufficient to illustrate the statement that the problem has never been studied by a consistent monographer who was willing to give undivided attention to the group.

The work of Miers, while a careful compendium, is limited in its scope, as the title suggests, and frequently is labored and ambiguously composed. It is always lacking the proper contrast to make a monograph usable. The monograph is moreover entirely without keys, except for a key to the genera of the tribe Tabernaemontaneae. In careful examination of the work, one is struck with the unfortunate fact that although the author makes innumerable new combinations, species, and even genera, actually

[17] A. Gray, Syn. Fl. N. Am. 2^1: 79–85. 1878.

[18] K. Sch. in Engl. & Prantl. Nat. Pflanzenfam. 4^2: 109–189. 1895.

sixty per cent of the species and genera (frequently new) were known to the author only at second hand. Further reference to the work of Miers will perforce frequently be made throughout these studies.

Since the last intensive work upon the system of the Apocynaceae was published over a half century ago, it may not be surprising that further study of the group should result in an attempt to readjust its divisions. Recent studies during several years have resulted in the following new classifications of the family:

Fam. APOCYNACEAE

Lindl. Nat. Syst. ed. 2, 299. 1836; Endl. Gen. Pl. 577. 1838; A. DC. Ann. Sci. Nat. Bot. **3**[1]: 235. 1844; in DC. Prodr. **8**: 317. 1844; Benth. in Benth. & Hook. Gen. Pl. **2**: 681. 1876; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 109. 1895.

Apocineae Juss. Gen. Pl. 143–151. 1789, *in part.;* R. Br. Mem. Wern. Soc. **1**: 12–58. 1809.

Subfam. I. ECHITOIDEAE

K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 160. 1895, *in part.*

Stamens largely sterile, basally appendaged, the anthers 4-locular, connivent about the clavuncle, pollen tetrads separating into individual grains; ovary apocarpous; corolla variously appendiculate within, or naked; calyx bearing various glandular appendages within, or rarely (?) naked. Woody vines or clambering shrubs, rarely rhizomatous herbs.

Subfam. II. APOCYNOIDEAE, n. subfam.

Stamens largely sterile, basally appendaged, the anthers 4-locular, becoming 2-locular at maturity, connivent about the clavuncle, pollen in persistent tetrads; ovary apocarpous; corolla appendiculate within by 5 individual or coalesced flanges opposite the corolla-lobes and alternate with the stamens; calyx naked within. Rhizomatous herbs.

Subfam. III. PLUMEROIDEAE

K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 122. 1895.

Anthers completely fertile, not basally appendaged, 4-locular, free, not connivent about the clavuncle, pollen tetrads separating into individual grains; ovary apocarpous or syncarpous, bi- or occasionally uni-locular; corolla variously appendiculate within, or naked; calyx naked, or bearing various glandular appendages within. Trees, woody vines, and shrubs, rarely rhizomatous herbs.

Tribe 1. PLUMIEREAE K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4^2: 122. 1895.
Ovary apocarpous, follicles two.

Subtribe A. *Tabernaemontaninae* K. Sch. *l. c.* 1895.
Calyx bearing numerous glandular appendages within, fruit pulpy.

Subtribe B. *Alstoniinae* K. Sch. *l. c.* 1895.
Calyx unappendiculate within, fruit dry.

Tribe 2. PLEIOCARPEAE K. Sch. *l. c.* 1895.
Ovary apocarpous, follicles more than 2.

Tribe 3. RAUWOLFIEAE, n. tribe.
Ovary syncarpous, bilocular, placentation axile.

Tribe 4. ARDUINEAE K. Sch. *l. c.* 1895.
Ovary syncarpous, unilocular, placentation parietal.

In the present studies, investigation was commenced about the genus *Apocynum*, so an attempt to express the natural relationship in the Apocynaceae naturally centers about Schumann's inclusive subfamily Echitoideae (including the new sub-family Apocynoideae) to which that genus pertains.

MORPHOLOGICAL AND PHYLOGENETICAL DISCUSSION

Before undertaking a discussion of the differences separating the Apocynoideae and the Echitoideae, a few words justifying the foregoing system of Apocynaceae as a whole may be *à propos*. It will quickly be perceived that the new system proposed is an almost complete reversal of Schumann's system elaborated in 'Die natürlichen Pflanzenfamilien.'

The general theme in Schumann's system is elaboration. In separating the two subfamilies Plumeroideae and Echitoideae

Schumann bears in mind the popular conception that sterilization of tissue is an "advanced" condition, and so places the divisions in the above sequence, since the former group includes genera with completely fertile anthers in contrast to the latter which includes genera with largely sterile, appendiculate anthers. Such a view is generally logical, but may be superseded by additional considerations.

With the exception of the genera of Apocynoideae, excluded in the foregoing section, the Echitoideae as visualized by Schumann presents a group of genera which are relatively homogeneous from a morphological and phylogenetical point of view. All genera are distinctly apocarpous. All genera, with few exceptions, as *Nerium*, and with some modifications, such as coalescence (cf. *Odontadenia*, etc.) and reduction of the number of units (cf. *Dipladenia*, etc.), display a cycle of vestigial nectaries surrounding the carpels. All genera, as far as is known at the present, display the appendiculate condition of the calyx. The group as a whole is an exceedingly natural one.

Such, however, is not the case of the subfamily Plumeroideae. The phylogenetical range is wide. Some genera, it is true, are so similar to those of the Echitoideae that only the complete fertility of the anthers bars them from that classification. Such genera, of course, are apocarpous and display a squamelliferous calyx and a cycle of nectaries about the gynoecium. However, gradations appear from that condition, through degeneration of the calyx squamellae and vestigial nectaries with gradual coalescence of the apocarpous carpels, to a condition of a syncarpous (occasionally even unilocular) gynoecium and a completely naked calyx and receptacle. In some genera, as in *Stemmadenia* and *Tabernaemontana* respectively, the coalescence and subsequent disappearance of the nectaries are accomplished through adnation to the gynoecium, thereby exerting an unmistakable influence towards syncarpy[19]; in others the nectaries disorganize without visible trace, as in *Amsonia*. The Plumeroideae, then, are a very heterogeneous group, and one which shows the effects of evolution clearly. The tendencies manifest in it, moreover, are more

[19] *cf.* Woodson, R. E., Jr. A revision of the genus Stemmadenia. Ann. Mo. Bot. Gard. 15: 347–349. *fig. 1.* 1928.

varied, and of a more "advanced" nature than those in the Echitoideae. It appears unfortunate, therefore, that Schumann considered the mere sterilization of the anthers of such importance that he was led to interpret the Plumeroideae as demonstrating a "primitive" condition.

In his tribal divisions of the Plumeroideae Schumann is rather difficult to follow. In his system lower genera have a syncarpous, unilocular ovary with two lateral parietal placentae, while more advanced genera pass through a syncarpous, bilocular stage with axile placentation to complete apocarpy. Moreover, lower genera have unappendaged, eglandular calyces, while higher genera gradually develop distinct, orderly calycine appendages. Such a system has philosophical justification, perhaps, but should be superseded by more natural considerations.

In the system which is here proposed, therefore, the order of Schumann in the Plumeroideae has been reversed, and we presume that lower, or more primitive, genera have an apocarpous ovary and progress through bilocular syncarpy with axile placentation to higher, or more advanced, genera with unilocular syncarpy and parietal placentation. An illustration of this is furnished in text-fig. 1, which presents diagrams of ovary cross-sections of three representative genera of Plumeroideae, namely, *Amsonia*, *Ambelania* and *Allamanda*. It will be seen that in *Allamanda* the irregular, binate, parietal placentations are sterile in the central region, hinting strongly that a transverse fission of the septum separating a bilocular ovary has resulted in a more or less unilocular condition. Such a view of the advanced condition of the syncarpous unilocular ovaries is strengthened by recapitulatory evidence in the very young stages where they appear as bilocular with axile placentation, much resembling the diagram of *Ambelania* in text-fig. 1. We may be fairly sure, then, that as a matter of fact the bilocular axile type is the forerunner of the unilocular parietal type.

Certain Gentianaceous ovaries, as those of *Frasera* and *Halenia*, unilocular with parietal placentation when mature, also display axile placentation when immature. Anatomically, an explanation of such a process of ovarian evolution appears relatively simple, since the "margins" of the apocarpous carpels forming the binate

axile placentations are never completely coalesced, and in microscopical preparations may be seen to be anatomically separate (cf. text-fig. 4, diagram 6, and text-fig. 7, diagrams 10–14). Therefore, in order to obtain a unilocular parietal ovary from a bilocular axile ovary, it is necessary only to project the coalescence of the carpels of the ovary and the widening of the breach between the halves of the binate axile placentae in either carpel, thus forming an unilocular parietal condition. As a matter of fact, the stages of such tendencies are frequently found in transverse sections of the ovary of *Nerium*, especially towards the apex of the ovary cavities.

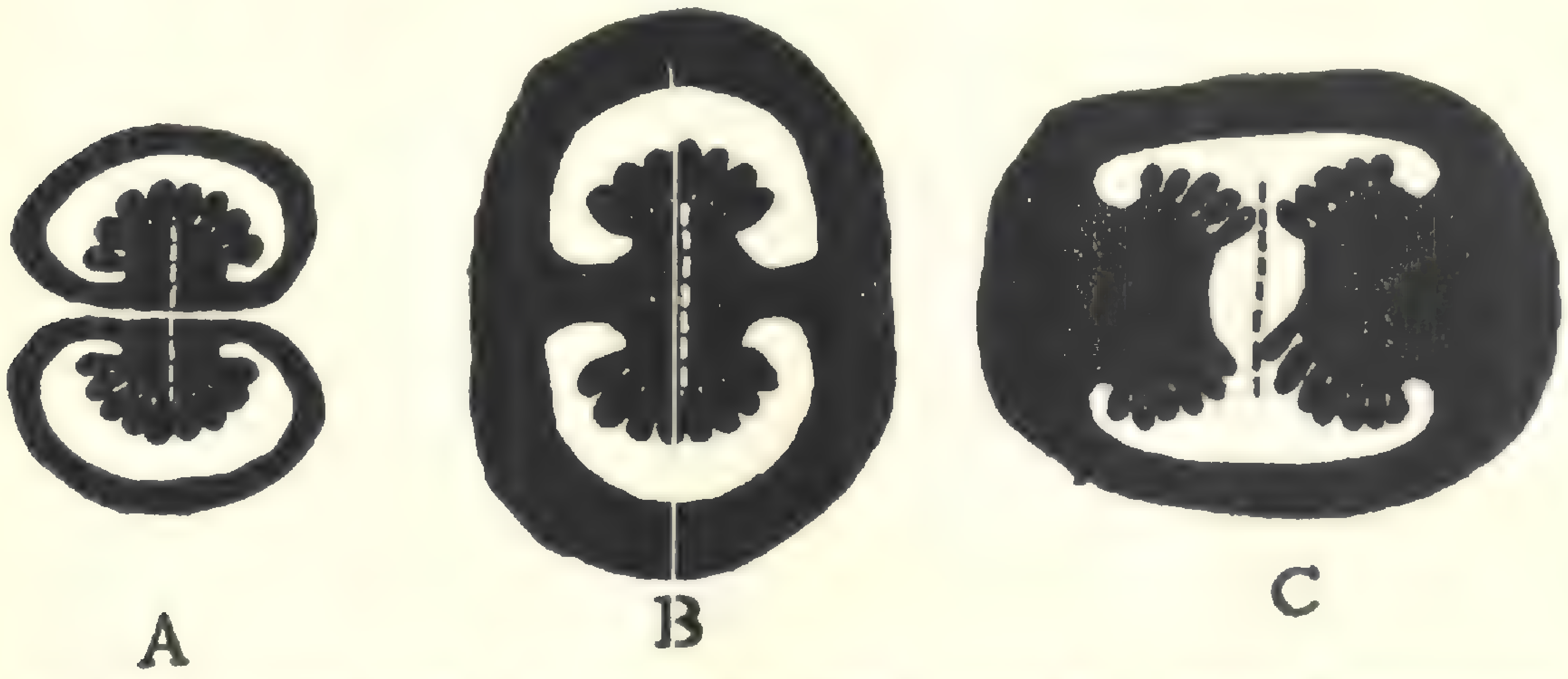

Fig. 1. Diagrammatic transverse sections of ovaries of various Plumeroideae. A: *Amsonia ciliata;* B: *Ambelania tenuiflora;* C: *Allamanda cathartica.*

The separation of the Apocynoideae and the Echitoideae upon the basis outlined just preceding is supported by a morphological and anatomical study of the floral mechanism of those subfamilies. For this study, fresh flowering material was available only in the case of the genera *Apocynum* and *Nerium*. For an understanding of the exotic genera, herbarium specimens were employed. All material was embedded in paraffin, sectioned at 5–10 μ, and stained with anilin safranin used in combination with either *licht gruen* or gentian violet. The combination of Delafield's haematoxylin with safranin also proved very satisfactory.

Herbarium material requires special technique in order to prepare it for the microtome, and to meet that need the following procedure is followed. The specimens are carefully chosen, care being taken to detach only fragments affected at a minimum

by pressing. The fragments are placed in a vessel containing distilled water and heated to about 90°C. The material is then placed in a Stender dish containing the heated distilled water, covered and placed in an oven thermostatically heated at about 60°C. Although the time of soaking in the oven varies with the condition of the fragments, twenty-four hours is probably a minimum and a week a maximum.

After the material appears properly soaked, it is removed to a vial containing Farmer's Fluid (six parts absolute alcohol; one part glacial acetic acid). After at least twenty-four hours in that fluid, it is washed in absolute alcohol where it may be left for an additional twenty-four hours. Xylol can then be added gradually to the absolute alcohol, eventually attaining purity. The xylol is in turn gradually replaced by paraffin. It is well to leave the material in pure paraffin for some time before imbedding and sectioning,—a week proved favorable in most cases. While the schedule given above is purely tentative, and lacks refinements in many details, notably the clearing reagent employed, very satisfactory serial sections were cut of over forty genera of Apocynaceae by that method. Flowers treated in that manner proved satisfactory for morphological and anatomical study even after fifty to seventy years of desiccation.

As outlined in the preceding section, the chief characters of cleavage between the Apocynoideae and the Echitoideae are the presence or absence of calycine squamellae, and the state of the mature pollen.

A study of the pollen of the three genera of the subfamily Apocynoideae has demonstrated that the pollen of those genera always develops and matures in persistent tetrads, the grains never normally becoming separated. On the other hand, the mature pollen of the genera of Echitoideae apparently always occurs as single grains, the tetrads breaking up relatively early in the life of the anthers. These observations have been made after microscopic studies of the more important genera selected at random throughout the subfamily, including inhabitants of all the major land divisions of the earth. The Echitoideae share with the Plumeroideae the individual condition of the pollen grains at maturity.

The calyx of the Apocynoideae is naked within; while the calyx of the Echitoideae is glandular-appendiculate within, although the individual appendages, or squamellae, may be extremely reduced and inconspicuous. The squamellae are found most frequently in groups opposite the calyx-lobes. In such genera as *Prestonia* and *Echites* there may be only a single squamella for each lobe of the calyx. The genus Cycladenia probably exhibits the most reduced form of the calycine appendages, where they appear merely as an almost microscopic fringe. In *Prestonia,* however, they are very conspicuous, and frequently equal in size the lobes of the calyx. The squamellae are thought to be of phylogenetic interest because of their histology and teratology.

For an histological study of the squamellae of the Echitoideae, fresh material was available only for the genus *Nerium.* However, preparations were also made from herbarium specimens of *Prestonia mexicana, Echites umbellata, Echites* n. sp., *Odontadenia speciosa, Macrosiphonia hypoleuca, Mandevilla tubiflora, Cycladenia humilis, Neobracea valenzuelana, Elytropus chilensis, Wrightia tinctoria,* and *Anisolobus Andrieuxii.* Two species of *Nerium* were studied, namely, *N. odorum* and *N. Oleander,* but since they proved practically identical from an histological standpoint, at least in regard to the details under observation, only the generic name will be used when reference to either species is made.

Text-fig. 2, diagram 7, illustrates the floral diagram of *Nerium.* The flower is seen to consist of a bicarpellate center (*c*) surrounded by cycles of fives. Between the calyx (*a*) and the corolla (*b*) and opposite the lobes of the former are situated the squamellae (*d*) in groups of various numbers of individuals. Plate 2, fig. 1, represents a longitudinal section of an individual appendage subtending a lobe of the calyx. A central core (*a*) is composed of vertical, elongate cells which are tapered at either end, somewhat resembling vascular cells. No spirally thickened cells are discernible in the organ itself, but one is occasionally able to find immediately below it, in the thickened receptacle, traces composed of spirally thickened cells (*c*) leading directly to the squamella. At right angles to the central conducting core of the squamella are found horizontally compressed cells rich in cytoplasmic content, forming a conspicuous glandular tissue (*b*). The nuclei of

the glandular cells are found to be chiefly in the region of the proximal half near the transverse wall adjoining the "conductive" or core tissue, apparently indicating a physiological relationship between the two tissues.

Floral anatomy in recent years has endeavored more and more

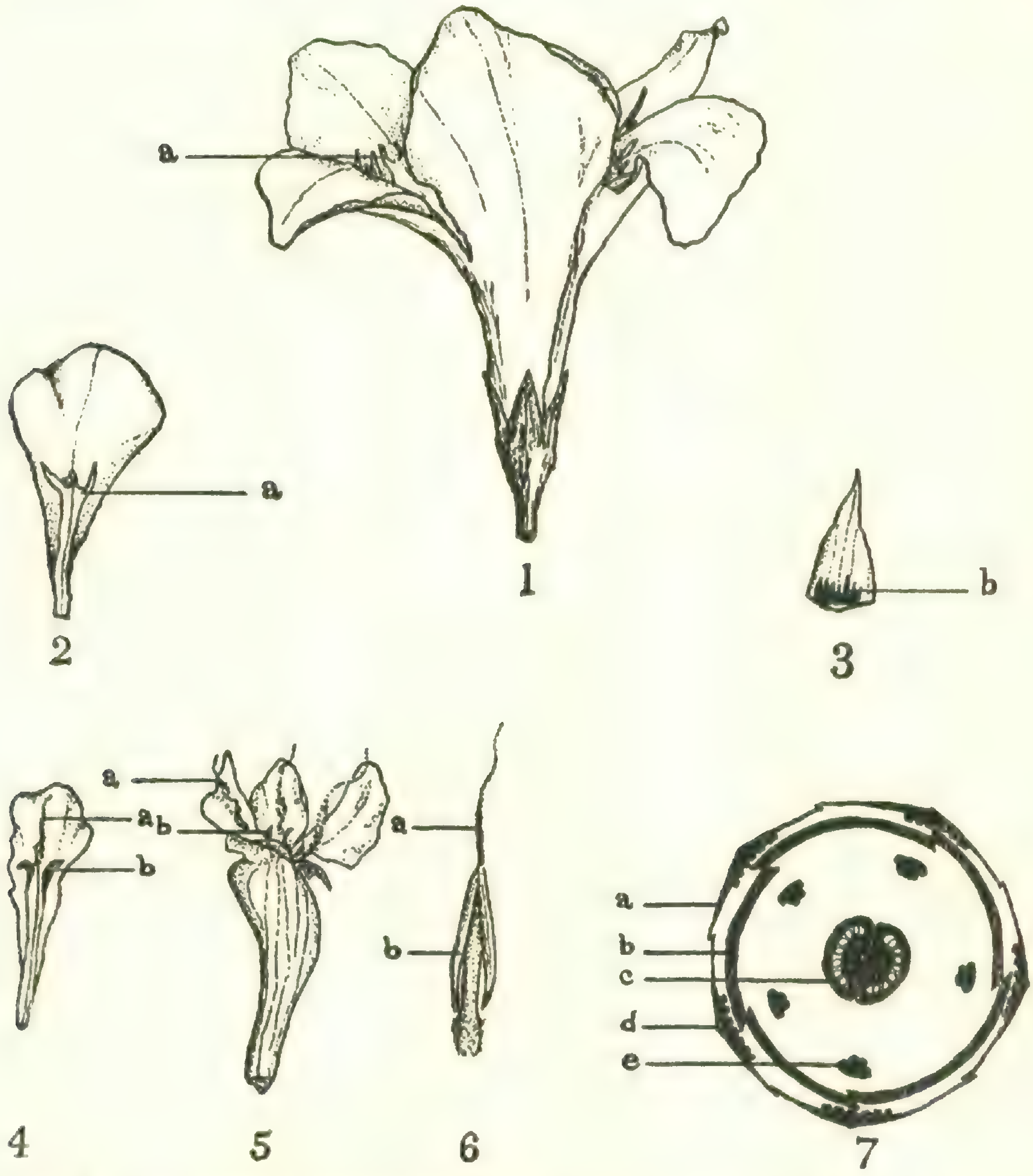

Fig. 2. The flower of *Nerium Oleander*. 1: habit; 2: ventral surface of corolla-lobe, illustrating the tridentate flange, *a*; 3: ventral surface of calyx-lobe, illustrating the calycine squamellae, *b*; 4: ventral surface of petalode, illustrating the staminal anthers, *b*, and rostrum, *a*; 5: connate mass of petalodes, illustrating the staminal anthers, *b*, and rostrum, *a*; 6: stamen, illustrating rostrum, *a*, and anthers, *b*; 7: floral diagram illustrating the position of the calyx, *a*, corolla, *b*, gynoecium, *c*, squamellae, *d*, and androecium, e.

to explain structures casually described by systematists, and has thus contributed greatly to phylogenetical study. The morphologist and the anatomist have frequently been aided or even inspired by teratological objects. The elder de Candolle depended frequently upon teratological observations for his morphological interpretations, and even declared that it was his belief that the morphology of *Begonia* could probably best be clarified by the appearance of a monstrosity. Robert Brown interpreted several teratological structures as reversionary, and recently the theory of "Carpel Polymorphism"[20] has had its inception after the appearance of teratological carpels of *Matthiola*. Generally speaking, the evolutionary theory has been immensely helped by the discovery and careful interpretation of monstrosities.

With the exception of *Vinca*, *Nerium* is probably the most widely cultivated genus of Apocynaceae. The intensive cultivation to which it has been subjected has produced several races of double-flowered forms. While the petalody is occasionally of the stamens, producing supernumerary petals within the true corolla, by far the most frequent condition is for the supernumerary petals to be produced between the true corolla and the calyx. If such a double flower is dissected it will be perceived that the supernumerary petals are of very unequal size (text-fig. 3), grading from petals equalling the lobes of the true corolla to inconspicuous and malformed filaments much smaller than the lobes of the calyx. If the calyx is examined for squamellae in such a case, it will be found that they are either absent, or extremely reduced in numbers. That the double flowers of *Nerium* are produced by petalody of the squamellae has long been appreciated and the occurrence has been called "adenopetaly" by Morren,[21] who also noted it under somewhat similar circumstances in the flower of *Lopezia*. Among the Apocynaceae, adenopetaly has also been found to contribute to the double flower of *Tabernaemontana Coronaria*.

If the supernumerary petals of *Nerium* are examined carefully (text-fig. 3), it will be seen that they are almost exactly similar, from the largest and most perfect to the most inconspicuous and

[20] Saunders, E. R. Ann. Bot. 38: 451–482. 1923.
[21] Morren, C. Bull. Acad. Roy. Sci. Belg. 17^1: 516–524. 1850.

malformed, to the lobes of the true corolla if those organs were polypetalous. As a matter of fact, in the double flowers the hint of reversion is frequently heightened by the partial dialysis of the gamopetalous corolla. This similarity is strikingly illustrated by the presence of the conspicuous tridentate flange which the corolla lobes bear upon their ventral surface. Similar flanges are borne upon each of the supernumerary petals except when those bodies are reduced to mere filaments, which occasionally occurs.

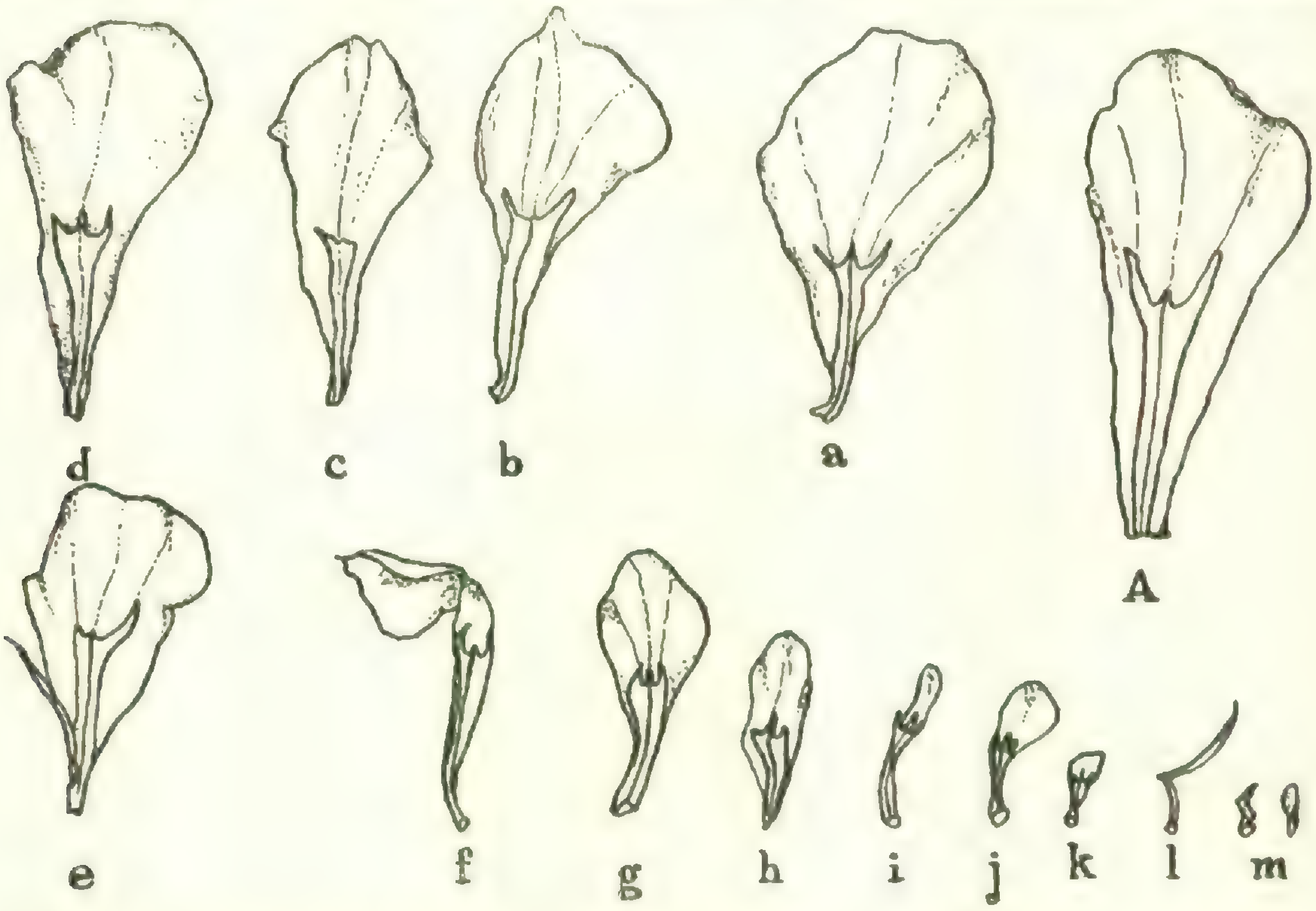

Fig. 3. Adenopetaly in *Nerium Oleander*: *A*, lobe of normal corolla; *a-m*, supernumerary petals, illustrating gradation to squamellae.

Histological preparations of the double flowers disclose the fact that the vascular traces which were seen occasionally to lead to the squamellae in the single flowers actually traverse the supernumerary petals in the double flowers. Plate 2, fig. 5, represents a cross-section of a supernumerary petal of *Nerium* illustrating the vascular system which is exactly similar in number of traces and cellular constitution to that of the corolla-lobes. Fig. 2, of plate 2, illustrates the longitudinal section of a supernumerary petal, to contrast with the longitudinal section of the squamellae in fig. 1 of the same plate. Text-fig. 2 illustrates the gross morphology of the flower of *Nerium*. Diagram 1 represents

the habit of the flower, diagram 2, the ventral surface of the corolla-lobe indicating the tridentate flange (*a*), and diagram 3, the ventral face of the calyx-lobe indicating the group of squamellae (*b*). Text-fig. 3 illustrates the stages of adenopetaly in a double flower from a normal corolla-lobe (*A*) to the smallest of the supernumerary petals (*m*).

The significance of the tridentate flange upon the ventral face of the corolla-lobes and supernumerary petals is also interpreted through teratology, it is believed. Text-fig. 2, diagram 5, illustrates petalody of the stamens of a double flower of *Nerium*. The connate stamens have in this case formed a gamopetalous pseudo-corolla composed of five petaloid stamens. If this teratological structure is dissected, it is seen that each of the five lobes (diagram 4) is composed in a manner similar to those of the corolla (diagram 2) and the supernumerary petals of the adenopetalous flowers (text-fig. 3 *a*–*m*). In some cases the staminode is completely sterile, while in others the ventral face of the organ bears two loculae of an anther (*b*) similar to those of a normal stamen (diagram 6), although conspicuously reduced in size. If the diagrams are examined carefully and comparatively, it will be seen that the blade of the staminodes (and consequently the corolla-lobes and the adenopetalous supernumerary petals) is equivalent to the filament and connective of the stamen (diagram 6), while the lateral and median lobes of the flange are equivalent to the anther-lobes (*b*) and the elongate rostrum (*a*) of the stamen, respectively.

Somewhat more precise information concerning the vascular relationships of the single and double flowers of the Oleander may be obtained by an examination of microscopic preparations of serial transverse sections.

Text-fig. 4 presents a series of diagrams of transverse sections of a single flower of *Nerium* to illustrate the origin of the vascular supply of the floral organs. Diagram 1 represents the vascular constitution of the pedicel just below the gradual enlargement of the receptacle. The stele is in the form of a hollow cylinder, and although circular in cross-section immediately after leaving the peduncle, it soon assumes the triangular form indicated in the diagram. Gaps are soon apparent in the triangular cylinder, as

successively higher sections are examined, and eventually the stage represented by diagram 2 is reached, where the stele is

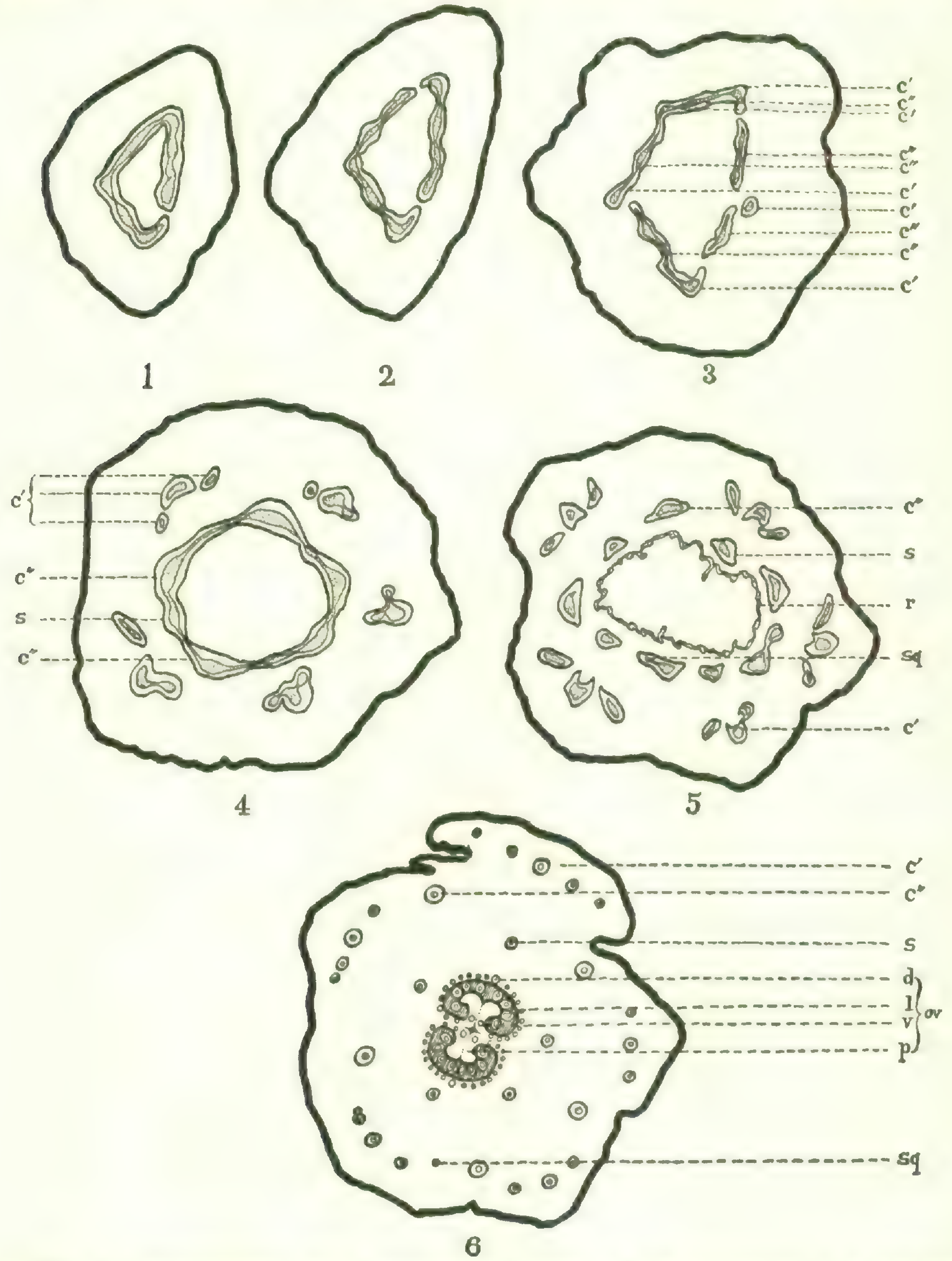

Fig. 4. Diagrammatic serial transverse sections of the receptacle of a single-flowered variety of *Nerium Oleander*. Explanation in the text.

broken in two opposite places, and is rather conspicuously and regularly lobed throughout.

When the stage represented by diagram 3 is reached, the calycine traces (c') have in all but one case partially detached themselves from the central cylinder, and the corolline traces (c'') are evident as conspicuous alternate lobes. The calycine traces almost immediately resolve into a stout dorsal trace and two finer ventral traces, evidently illustrating a case of the fusion of three traces at the place of departure from the central cylinder.

After the complete departure of the calycine traces, the isolated corolline lobes unite into a fairly well-defined five-lobed cylinder (diagram 4). This cylinder quickly becomes of relatively uniform thickness, after which, in the place of the five original lobes, *ten* lobes appear opposite and alternate with the calycine traces. These lobes eventually disengage into ten traces, five larger alternating with the calycine traces, and five smaller opposite traces. At the same time either cycle gives rise to numerous residual fragments, or bundles which remain towards the center of the axis (diagram 5). Diagram 6 illustrates the receptacle just prior to the full elaboration of the floral organs. Of the three cycles of traces other than the calycine, the five larger are found to give rise to the corolla-lobes, the five smaller to the stamen-filaments (*s*) which are adnate to the corolla-tube, and the numerous residual traces (*r*), frequently as many as forty or sixty, to the gynoecium. Although the reunited cylinder of the corolline and staminal traces regularly breaks up into ten traces, frequently extra traces originate (*sq*), and it is these traces (text-fig. 4, diagrams 5*sq*–6*sq*) which, in longitudinal sections, are found directly beneath the squamellar appendages (plate 2, fig. 1*c*). The significance of these extra traces may be appreciated from the phenomena described in the following paragraphs.

The early stages in the breaking up of the pedicellar stele are similar in both the double and the single flowers of *Nerium.* The stages diagrammed in text-fig. 4, diagrams 1–4, are almost exactly similar for both the single and the double forms. However, after the reorganization of the central cylinder after the departure of the calycine traces, the stele breaks up into a larger number of traces than was observed in the single flowers. In almost all cases, this number was twenty, in the manner indicated in text-

figure 5, diagram 4. Subsequent sections (text-fig. 5, diagrams 5–6) proved that these twenty traces were destined for two

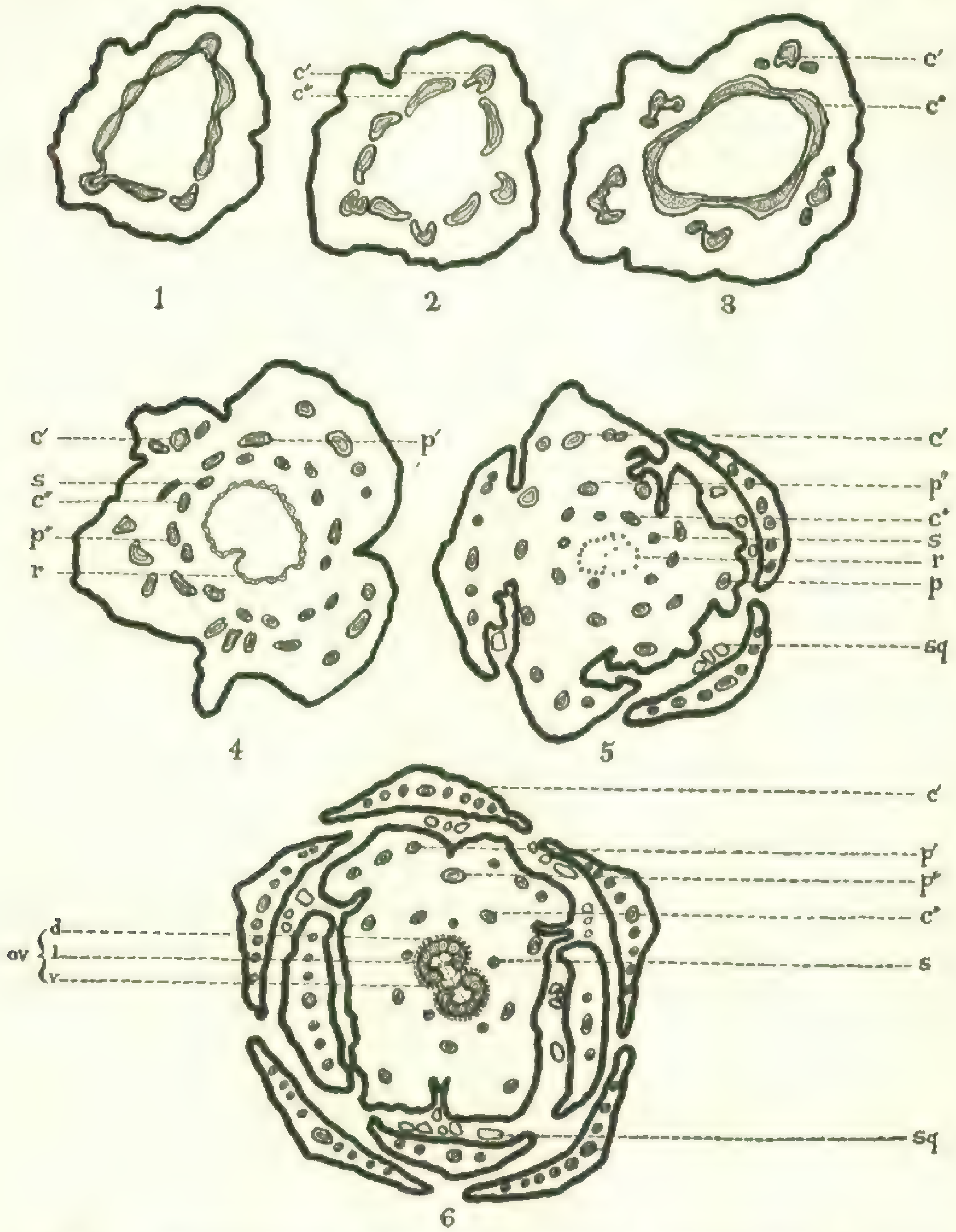

Fig. 5. Diagrammatic serial transverse sections of a double flower of *Nerium Oleander*. Explanation in the text.

cycles of exterior supernumerary petals in addition to the cycle of gamopetalous corolla and the cycle of epipetalous stamens.

The vascular traces traversing these supernumerary petals are similar to those of the true corolla in remaining unbranched until entrance into their respective organs. Both petals (including the supernumerary and the corolla-lobes) and stamen-filaments contrast with the calyx-lobes in possessing simple traces while within the receptacle.

While the supernumerary petals of *Nerium* were found in the vast majority of cases to be provided with vascular traces in the manner described in the preceding paragraphs, occasionally very reduced supernumerary petals were detected which contained no evident vascular supply. Thus in text-fig. 3, in addition to the corolla-lobe (*A*), the dissection of the particular double flower displays ten supernumerary petals supplied with conspicuous vascular traces (*a–j*) and four extremely attenuate appendages, larger than the normal squamellae, and evidently also greatly reduced supernumerary petals, but not vascularly supplied. Such extremely reduced supernumerary petals retain to a certain degree the glandular nature of the true calycine squamellae.

In view of the evidence presented, it is thought likely that in the possession of calycine squamellae the Apocynaceae, as well as certain other families of the Contortae, as the Gentianaceae, suggest a rather striking relationship with polyandrous polypetalous families of plants. Because of the extreme variability of the reversion of these organs in teratological varieties, due no doubt to very great reduction, the exact nature of a hypothetical polyandrous type cannot be described. However, it might be supposed that (from the evidence of the two cycles of vascularly supplied supernumerary petals) such an ancestor in all probability displayed at least two additional cycles of floral organs to those which occur in the modern flower (single), and possibly two cycles besides those, evidenced by the non-vascular appendages frequently detectable.

From what has been said in the preceding paragraphs, it will be perceived that the stamens, corolla-lobes, and supernumerary petals are believed to be homologous. It is also believed that in the single flowers the supernumerary petals are represented by the squamellae. In other words, the squamellae are held to *represent* staminodia. The case of staminody, however, is considered

so extreme that constancy in numbers and arrangement has disappeared. The importance of the squamelliferous calyx, however tenuous the explanation, must be accounted for nevertheless because of its almost universality in the Apocynaceae and its frequency in other families of the Contortae, as in the Gentianaceae. Of course to clinch the theory that the squamellae represent staminodia it would be necessary to find, perhaps, a teratological specimen upon which the squamellae had become not only petaloid but antheriferous. However, this condition is virtually obtained by the presence of the dorsal flange, which we have seen in the foregoing paragraphs and accompanying figure to be the homologue of the anther. Reasons accounting for the presence of the "staminodial" squamellae outside the gamopetalous corolla will follow in a succeeding paragraph.

The mechanics of such centripetal sterilization as is projected to have occurred in some polyandrous form to produce a structure similar to the modern single flower of *Nerium* is evidently at work in many of the polyandrous Polypetalae of the world to-day. Such genera are *Nymphaea*, *Cactus*, *Mentzelia*, and many another, each of which displays the effects of progressive centripetal sterilization of the multiseriate androecium, from exterior completely sterile petaloid laminae to completely fertile interior stamens. The suggested explanation of the single flower of *Nerium* merely requires a continuation of sterilization in addition to the oft-invoked processes of reduction, coalescence and adnation.

An interesting and significant morphological feature which the Apocynoideae have in common with most Echitoideae is a cycle of usually five, fleshy, ovate-cylindrical nectaries surrounding the carpels (*cf.* text-fig. 10*f*). In the Apocynoideae the genera *Apocynum* and *Trachomitum* exhibit a cycle of five individual and distinct bodies, while in *Poacynum* the nectaries are more or less united into a fleshy annulus about the gynoecium.

In the Echitoideae the nectaries may be either present or absent. The genus *Nerium* is a representative of the comparatively few genera in which they are lacking. When present, the nectaries usually number five, but may be reduced to three or two, as in *Dipladenia*. Although usually individual and separate, the nectaries are sometimes coalesced into an annulus closely investing the gynoecium, as in *Odontadenia*.

Examined histologically, the nectaries provide a fascinating study. Plate 3, fig. 2, represents diagrammatically a cross-section of the flower of *Apocynum androsaemifolium.* It will be seen that the nectaries (*e*) form a circle about the carpels (*d*), alternating with the filaments of the stamens (*a*). According to the diagram the carpels contain three traces each, as do also the nectaries. Plate 6, fig. 2, represents in more detail a longitudinal section through a nectary of the same species of *Apocynum.* It will be seen that the vascular element is practically identical with the traces found in the gynoecium and figured in the clavuncle in fig. 3 of the same plate.

For a more detailed knowledge concerning the interpretation of the nectaries, the vascular system of the flower of *Apocynum* was studied by means of serial transverse sections in a manner similar to that by which the squamellae of *Nerium* were studied. The diagrams in text-figures 6 and 7 illustrate this phase of the investigation, being numbered consecutively throughout the two figures.

In the pedicel of a flower of *Apocynum cannabinum* the stele is at first found to form a continuous bicollateral cylinder which is nearly circular in cross-section (diagram 1). Very soon, however, the triangular cross-section noted in the pedicel of *Nerium* replaces the circular (diagram 2). Still further towards the distal end of the pedicel the stele becomes still more angled, eventually assuming the five-angled appearance illustrated in diagram 3. This stage indicates the transformation of the pedicel into the receptacle.

In diagram 4, the five angles noted in the preceding diagram have become very prominent, and alternating with them are discernible five additional, lesser lobes. In diagram 5, the condition noted in diagram 4 has almost resulted in the disruption of the stele into ten discrete segments. These consist of a series of five prominently angled sectors, identifiable as the bases of the calycine traces (*c*′), and a series of five alternating broader segments destined for the corolla lobes (*c*″).

In diagram 6, the condition in the preceding diagram has become modified by the conspicuous bilobed appearance of the five prominently angled, or calycine, lobes of the receptacular

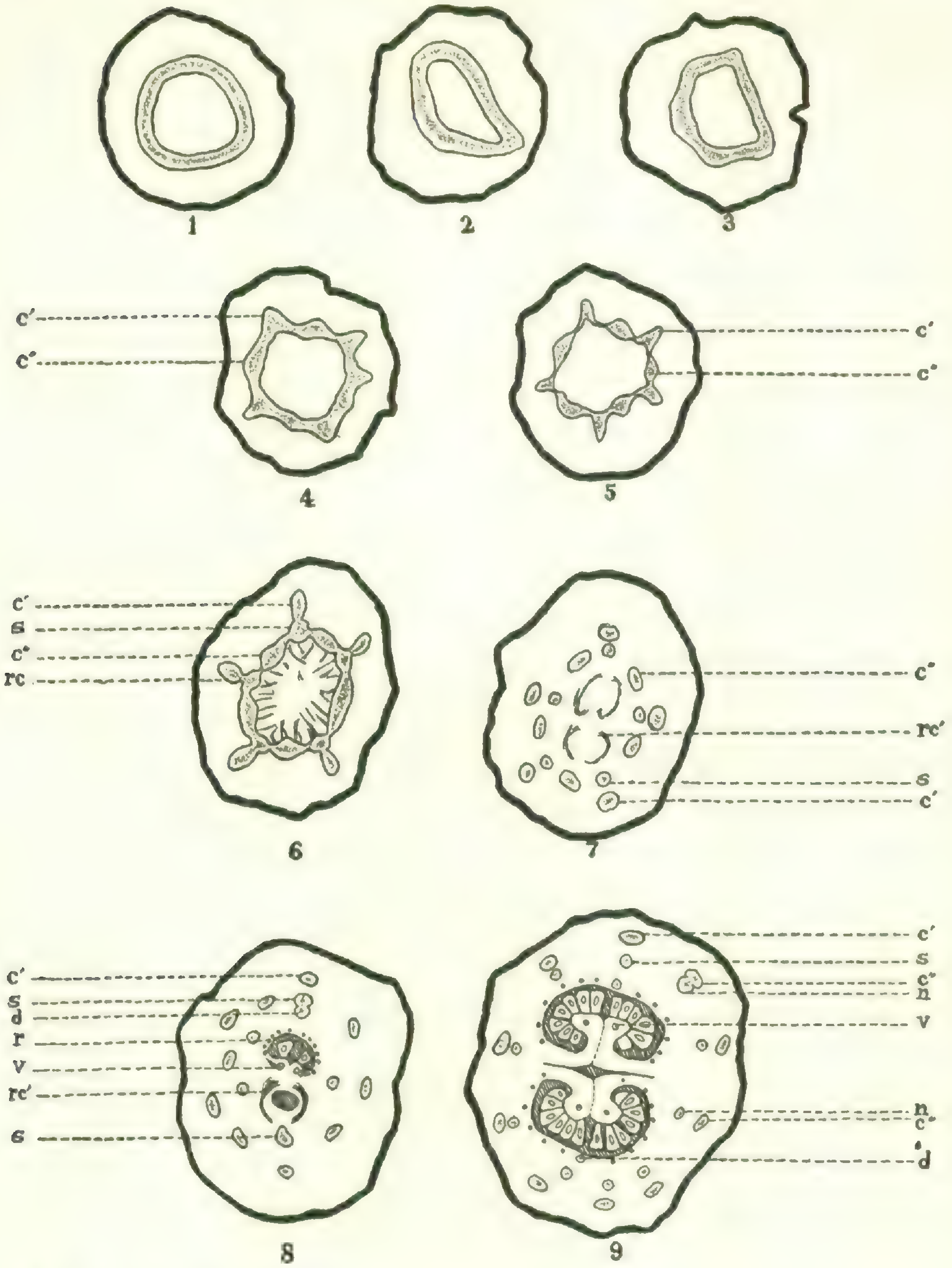

Fig. 6. Diagrammatic serial transverse sections of the flower of *Apocynum cannabinum*. Explanation in the text.

stele. As subsequent sections revealed, the dorsal lobe was destined for the calyx-lobe, whereas the ventral lobe would separate to supply the staminal filament (*s*). This condition is

evidently explained by the adnation of the calyx traces, or rather by their failure to depart promptly from the receptacular stele.

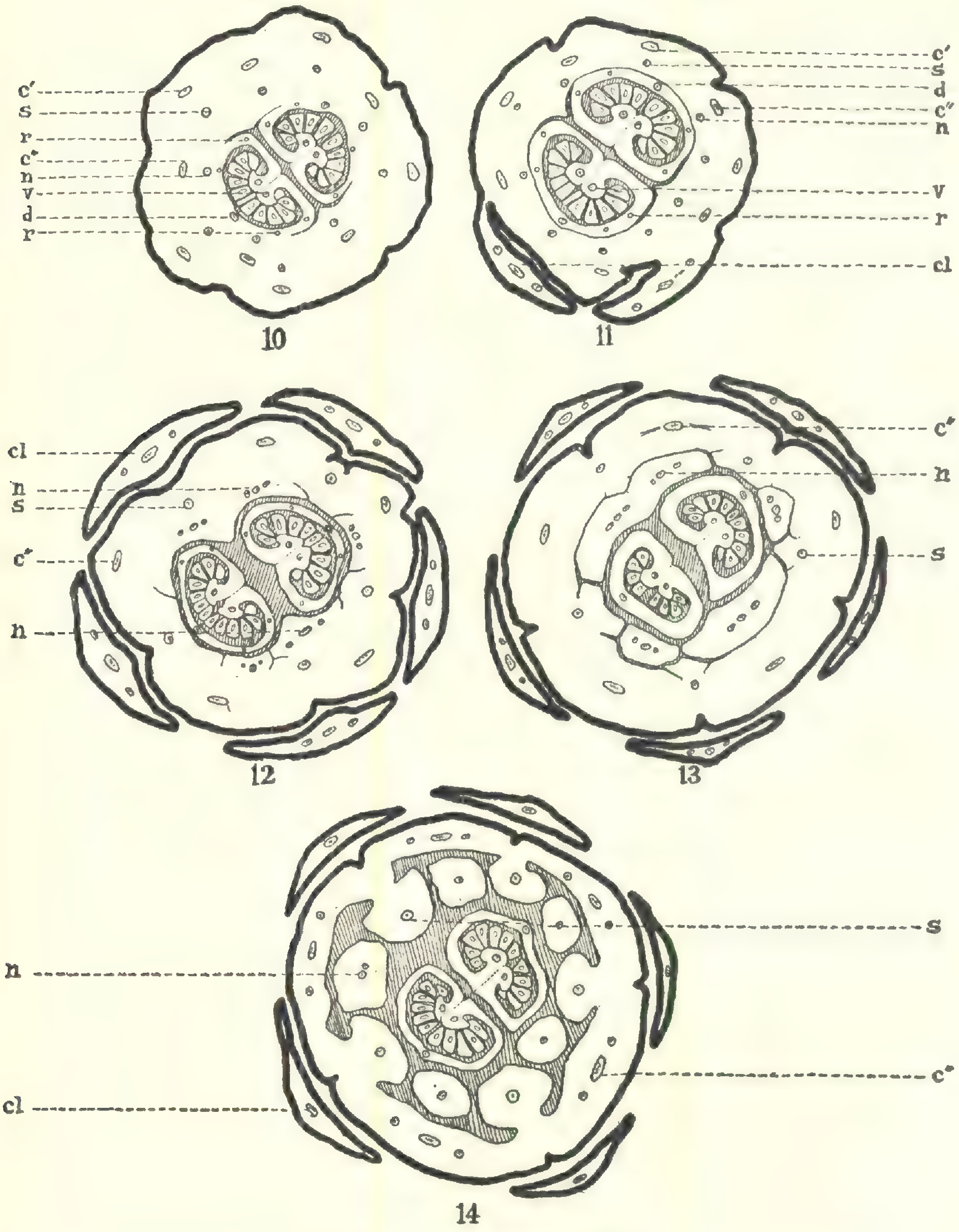

Fig. 7. Continuation of fig. 6.

This is appreciated by comparing text-fig. 6, diagram 6, with text-fig. 3, diagram 4, and text-fig. 4, diagram 3, of the genus *Nerium*, in which the calycine traces depart from the central

cylinder before the appearance of the staminal lobes. This situation, then, is an adnation of the calycine traces, rather than adnation of the staminal traces, as it might appear in longitudinal sections. In the same diagram (diagram 6), residual traces (*rc*) appear within the central cylinder, thus appearing in *Apocynum* at about the same stage in the development of the receptacle as was observed in *Nerium*.

In diagram 7, the central cylinder of the receptacle has at last broken up into calycine traces (c'), corolline traces (c''), and staminal traces (*s*). The residual traces (rc') have formed themselves into two irregular, lunate semicircles. This action of the residual traces may be visualized as a breaking up of the roughly circular form in diagram 6 (*rc*), and a very decided ventral development, producing the in-rolled semicircles illustrated in diagram 7 (rc').

In diagram 8, the first differentiation of the receptacle into floral organs is perceived in the appearance of the ovarian cavities. In the lower of the two cavities illustrated, the placentation has not yet formed, and the only vascular element is the semicircular formation of the residual traces. However, in the upper of the two cavities, the first evidence of placentation is perceptible, and coincidently it is found that the vascular equipment is nearly, although not quite, completed. The ventral, or ovuliferous, traces (*v*) of either carpel, as may be seen from this figure, are formed by the two in-rolled margins of the residual semicircular cylinders, while the lateral veinlets (*r*) usually found towards the base of the carpels also arise from the residual traces. In diagram 8, it will quickly be seen that midribs, or dorsal traces, are absent from the region of the ovarian cavities. However, the staminal trace nearest the region of the dorsal wall of the ovarian cavity where the dorsal trace should be found is discovered to be conspicuously bi-lobed. The ventral lobe of this compound trace eventually proves to be the dorsal trace of the carpel (*d*), which is adnate to the dorsal lobe, or proper staminal trace (*s*). In the upper ovarian cavity illustrated in diagram 8, the lobing of the compound staminal-carpellary trace is almost complete, while in the lower cavity the lobing has just begun to be noticeable.

In diagram 9, the elaboration of the ovarian cavities is completed.

The vascular constitution of either carpel is seen to consist of a dorsal trace, or midrib (*d*); two ventral, or ovuliferous traces (*v*); and several smaller lateral traces, usually completely unlignified, numbering about twelve. These lateral traces, formed after the disorganization of the semicircular cylinder of residual traces to which attention has been called in the preceding paragraphs, progressively reduce in number as additional sections are examined. In diagram 10 of text-fig. 7, either carpel is seen to contain four lateral traces. In diagram 13 of the same figure, the lateral traces have completely disappeared. In diagram 9, also, the cycles of calycine (*c′*), corolline (*c″*) and staminal (*s*) traces are conspicuous, and in addition another cycle of traces, alternate with the staminal, and opposite the corolline, are evident. These are the traces to the cycle of nectaries (*n*), and they arise from the lobing of the corolline traces (*c″*) in exactly the same manner as did the dorsal traces of the carpels from the compound staminal traces. The manner in which the traces of the nectaries (*n*) emerge from adnation with the corolline traces (*c″*) is illustrated in diagram 9, where a large corolline trace is found constricting to free the trace of the nectary to which it is adnate.

Text-fig. 7, diagram 10, discloses for the first time the floral traces assuming their final position. Furrowing has begun to distinguish the carpels from the surrounding receptacle. In diagram 11, the calyx-lobes are becoming free of the receptacle, whereupon the single calycine strands separate into a large dorsal and two small ventral branches. Furrowing has completed the differentiation of the ovary walls.

In diagram 12, the calyx-lobes are entirely free from the receptacle, and each contains three traces. The nectary traces have likewise divided into three traces, and the shapes of the nectary-bodies have begun to be visible due to the inauguration of furrows. Diagram 13 proves that, even in the genus *Apocynum* which is described as possessing discrete nectaries, two of the bodies may develop together, evidently providing a transition to the coalesced annular nectaries of *Poacynum*. In diagram 13, also, furrowing, which has differentiated the nectaries, has served to demark the bases of the epipetalous stamen-filaments. The corolline traces

(c'') soon branch, forming a strong dorsal trace and two finer ventral branches.

In diagram 14 the corolla-tube, adnate stamen-filaments, and nectaries are fully differentiated, as they are viewed in ordinary dissections. The lobes of the corolla each contain three traces, but the lateral traces of the calyx-lobes have disappeared, leaving only the midrib. The lateral traces of the nectaries have also disorganized, for the most part.

The foregoing discussions of the floral anatomy of *Nerium* and *Apocynum* are incomplete and lacking in detail, but they are included in the discussion to aid in the interpretation of the vestigial structures believed to be present in those genera. A detailed account of the floral anatomy of many representative genera of Apocynaceae is in the course of preparation.

From the immediately preceding paragraphs it has been explained with regard to the anatomy of *Apocynum* that (1) the vascular supplies of the carpels and the nectaries are of similar origin; (2) the carpels and the nectaries are similar in containing dorsal and ventral traces; (3) the bodies of the carpels and the nectaries differentiate from the receptacle in a similar manner and at about the same time. An additional similarity of the carpels and the nectaries is the fact that both are made up of highly glandular cells, and thus assume a similar staining reaction in microscopical preparation. For these reasons, in addition to certain others, as similarity in shape (*cf.* text-fig. 10), the nectaries are interpreted in this study as sterile carpels, and are considered as of great value in phylogenetical speculations concerning the Apocynaceae.

Of course if one is merely inclined to take the view that the nectaries are vestigial, and consider their number and alternate position with the stamens, they might be interpreted as staminodia. Such an interpretation of an inner cycle of staminodia has been adopted by systematists with regard to the nectaries of *Parnassia*, and recently Mrs. Arber[22] has expressed her approval of this view. On the other hand, subsequent studies may lead to the interpretation of these vestigial organs of *Parnassia* as sterile carpels, as in the case of *Apocynum*.

[22] Arber, Agnes. On the structure of the androecium in Parnassia, and its bearing on the affinities of the genus. Ann. Bot. 27: 491–510. *pl. 36. 4 figs.* 1913.

In a systematic arrangement of taxonomic units, one is forced to grant a prior position to some and a subsequent position to others. It is very difficult for most taxonomic systems to depict accurately the probable evolution and phylogeny of the particular group. In arranging the three subfamilies of Apocynaceae, one is confronted with the problem of which should be first enumerated, since that position is tacitly interpreted as the "most primitive." And although one realizes that evolution is so complex and phylogeny so incomplete that the true situation is inscrutable, one is nevertheless forced to a conclusion, and must reconstruct his personal conception of what the whole edifice of nature might have been were all the elaborate units of structure still extant, with only the meagre materials which he has at hand.

In deciding the question regarding the probable relation between the three subfamilies of Apocynaceae, one is confronted primarily by considerations of distribution, habit and structure.

Geographically, the Apocynoideae are sharply distinct from the other subfamilies of Apocynaceae in having a completely north temperate habitat. The genus *Apocynum* is found scatteringly in northern Mexico as far south as central Chihuahua, but there is apparently escaped from ballast. It is as nearly cosmopolitan over the United States and southern Canada, including Newfoundland, as almost any other genus native to this continent. *Trachomitum* is a more southerly genus, and is found in Adriatic Italy, in Asia Minor, and in Asia as far south as the Persian Gulf and as far north as the vicinity of Peiping. *Poacynum* is apparently confined to a small district in central Asia.

Since the overbearing majority of all Apocynaceae is distinctly tropical (only seven or eight genera out of a total of over two hundred are characteristically temperate), it has been presumed that the group has probably had a tropical origin. Hence, with such an assumption, the Apocynoideae might be taken as representing an advance from the tropical condition of the Echitoideae and the Plumeroideae.

Closely coinciding with the geographical conclusions are considerations of habit of the subfamilies. The Apocynoideae are rhizomatous herbs entirely, while the Echitoideae and Plumeroideae are woody vines, clambering or procumbent under-shrubs

or trees, primarily, since the herbaceous habit is only rarely found in those groups. However, of the two subfamilies the latter contains the more numerous and the more typical herbs. *Amsonia*, *Rhazya*, and *Vinca* are rhizomatous perennials of the Plumeroideae, the former genus frequently developing a woody condition of the rhizome. *Lochnera*, of the same group, contains the only annuals of the entire family.

In the Echitoideae the herbaceous habit is much more rare. *Cycladenia* is a small sub-alpine rhizomatous perennial. Several genera, as *Macrosiphonia*, *Dipladenia*, and certain species of the inclusive genus *Echites* (*cf. E. stans* A. Gray) have become diminutive under-shrubs, apparently on the verge of the herbaceous habit. The herbaceous condition is now almost universally viewed as an adaptation from a woody condition, and the fact that the Apocynoideae contain only herbaceous genera in contrast to the predominately woody genera of the other subfamilies should lend support to the hypothesis that that subfamily demonstrates a relatively "advanced" condition.

From the standpoint of structure, consideration naturally centers about the condition of the mature pollen and the interpretation of the vestigial organs. That the tetradenous pollen of the Apocynoideae should be considered as phylogenetically more advanced than the granular pollen of the other groups can scarcely be gainsaid. In the condition of the mature pollen, the Apocynoideae share with the Asclepiadaceae an interesting analogy with the Orchidaceae.

Since the Apocynoideae are interpreted as phylogenetically more advanced than the Echitoideae and Plumeroideae in other particulars, it might be reasonable to suppose that in the former subfamily the calycine squamellae have been totally effaced. Another view might be that the group is descended from an entirely different phylum than are the Plumeroideae and Echitoideae. Additional anatomical studies, it is hoped, will contribute to the elucidation of this problem. However, since it is known that the squamellae are eventually obliterated in certain genera of the Plumeroideae, the former view appears the more plausible.

Two recent memoirs concerning the phylogeny of the families of Contortae are of especial interest with reference to the family

Apocynaceae. The first is the portion of Wernham's[23] treatises on "Floral evolution" concerning the Contortae. In his deliberations, Wernham comes to the conclusion that the "apocynal stock," represented by the present family Apocynaceae, should be considered the most primitive group of the order Contortae and the Sympetalae as a whole. This conclusion is reached because that family, in general, demonstrates the simplest condition of all the families in its apocarpous, bicarpellate gynoecium. Although agreeing perfectly with Wernham's main thesis concerning the probable relationship between the Apocynaceae and the other families of the Contortae, several of his statements should be supplemented or modified in the light of the foregoing observations regarding the morphology of the family.

In conjecturing a group of Archichlamydeae which could possibly be regarded as offering a stock from which the Contortae (through the "apocynal stock") could be obtained, Wernham[24] exclaims: "A gulf is thus discovered between the Contortae and the Archichlamydeae which at first sight seems difficult to bridge; for the combination of an isomerous alternating androecium with a bicarpellary and *superior* ovary is extremely rare in the latter series—the sole group in which this combination occurs at all to *any extent* being the highly evolved Umbelliflorae, in which the ovary is inferior." Again he states: "In the Archichlamydeae, however, we must contemplate the tendency to economy from the aspect of its progress rather than of its realization; and the rarity of forms which have fully worked out this tendency before adopting sympetaly is scarcely matter for surprise. For the ancestry of the Contortae we must look for a group in which a tendency to isomery of the androecium is definitely traceable, together with a tendency to a bicarpellary gynoecium; at the same time *any tendency to epigyny must be absent*, or practically absent. These conditions are satisfied by the stock represented in the Geraniales-Sapindales plexus, and by no other." Still again he remarks: "Unfortunately, however, the Contortae have left no traces of their *progress from polypetaly* to sympetaly in the

[23] Wernham, H. F. Floral evolution: with particular reference to the sympetalous dicotyledons. New Phytologist **10**: 217–266. 1911.

[24] *l. c.* 220. 1911.

shape of *pentacyclic forms;* neither a second staminal whorl nor *any hint* of it *ever* occurs." The italics are ours.

The treatises of Wernham, it may be said, are quite generally stimulating to the study of phylogeny, which, as some critics have remarked, is the only phase of taxonomy which at present appears to have any vitality. However, as is evident from the few quotations which have been included in the preceding paragraph, his opinions, like those of many another phylogeneticist, were very evidently formulated from faulty morphological observations. Although by no means representing all points of objection and exception which might be made to Wernham's phylogenetical ideas, several of his misleading morphological remarks should be recalled, namely: (1) that the ovary of the Apocynaceae is superior, and hence that "any tendency to epigyny must be absent, or practically absent" in a prospective hypothetical group of ancestors for the family; (2) that in the Apocynaceae there are "no traces of their progress from polypetaly in the shape of pentacyclic forms"; and (3) that "neither a second staminal whorl nor any hint of it ever occurs."

As early as 1857, Payer[25] referred to the genus *Apocynum* as an excellent example of the ontogenetical adnation and coalescence of floral parts. In his morphological experiments Payer found that in very young flower buds the corolla of *Apocynum* is polypetalous, the pistil completely apocarpous, and the stamens free from the corolla. To these observations of Payer, all of which have been independently confirmed during the course of these studies, additional ontogenetical details have been added.

Diagrams illustrating two stages in the development of the flower of *Apocynum hypericifolium* are presented in text-fig. 8. In diagram *A*, the ovary appears inferior and the young stamens epigynous and organically free from the corolla. The receptacle is adnate to the whole outer surface of the carpels except at the apex where the clavuncle has not yet been formed by the fusion of the carpellary apices. In diagram *B*, the flower has assumed its mature condition. The stamens are now perigynous, for the carpels have developed above the surface of the receptacle. The

[25] Payer, J. B. Traité d'organogénie comparée de la fleur 1: 564–565; 2: *pl. 116*. 1857.

bases of the stamen filaments, meanwhile, have fused in their superficial tissue with the base of the corolla-tube, thus developing their epipetalous position. However, as pl. 3, fig. 4 clearly demonstrates, this adnation of the filament to the corolla is scarcely complete adnation, for the vascular element of the stamen fuses with that of the corolla-tube only below the surface of the receptacle. The surrounding cells of the filament, moreover, never completely lose their identity in the adnation with the corolla.

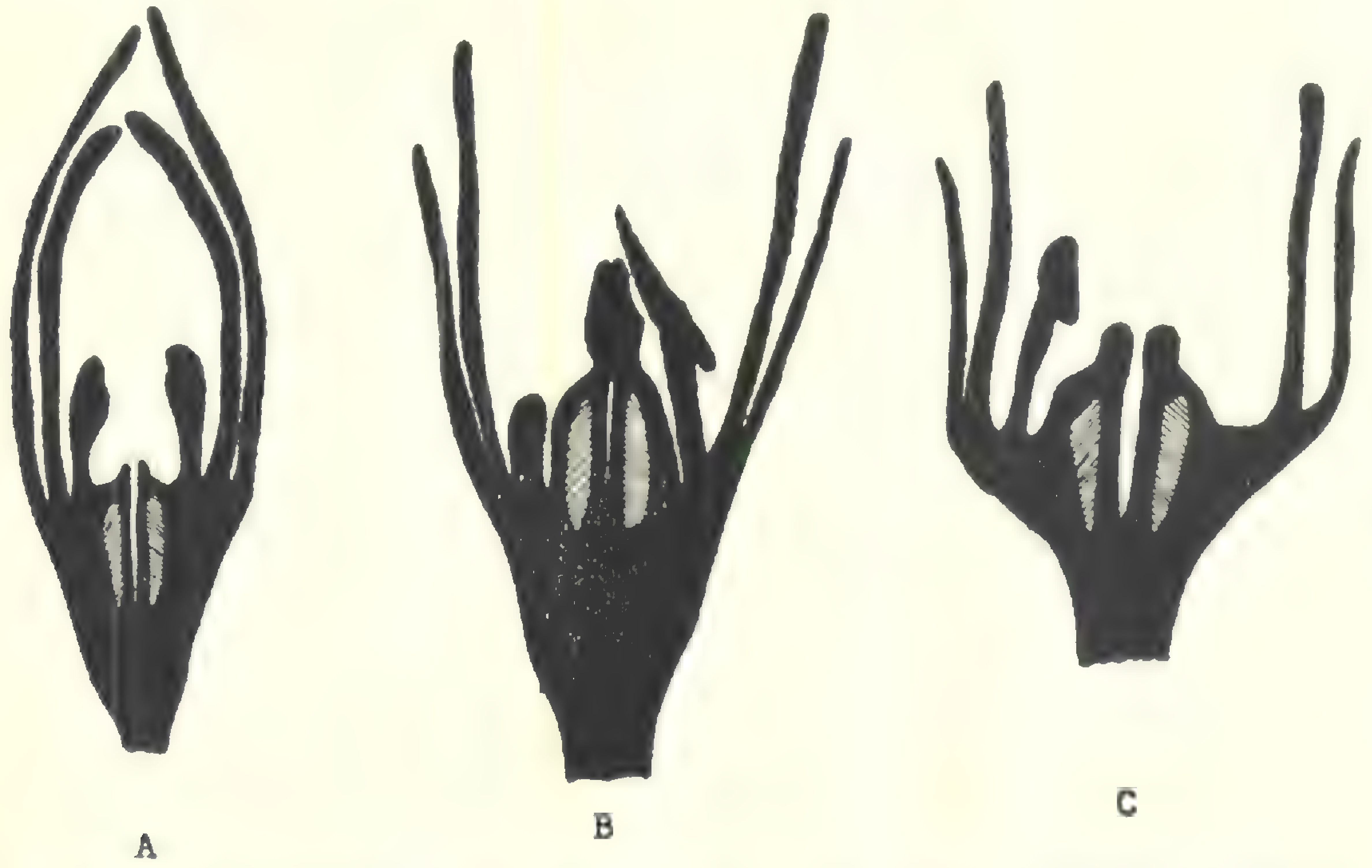

Fig. 8. Diagrammatic longitudinal sections of the flowers of species of *Apocynum* and *Saxifraga:* A, young bud of *A. hypericifolium;* B, mature flower of same; C, mature flower of *S. nivalis.*

As text-fig. 8, diagram *B*, illustrates, the ovary of *Apocynum* never becomes completely free of the surrounding receptacle, for the loculae are seen to penetrate into it. This penetration of the loculae is also conspicuous in the transverse sections of *Nerium* (text-figs. 4–5) and *Apocynum cannabinum* (text-figs. 6–7). This condition has been called "subinferior" by Dr. A. M. Johnson[26] and certain other specialists who note its occurrence in the genus *Saxifraga* and throughout the family Saxifragaceae in varying

[26] Johnson, A. M. A revision of the North American species of the section Boraphila of the genus Saxifraga (Tourn.) L. Univ. Minn. Biol. Studies 4: 6. *pl. 3.* 1923.

degrees. A diagram of the mature floral structure of *Saxifraga nivalis* in longitudinal section is presented in text-fig. 8, diagram *C*.

That the floral structure of the Apocynaceae is fundamentally pentacyclic there can be little room for doubt. The floral envelopes, the androecium, the groups of squamellae and nectaries, are invariably in fives. The gynoecium alone being bicarpellate, typically, would appear to detract from the 5-merous symmetry. However, a 5–8-carpellate gynoecium actually occurs in the family in the genera of the tribe Pleiocarpeae. The case of the Pleiocarpeae can scarcely be viewed as other than an indication of the primitive condition of the family, in the light of what phylogenetic studies in general, and the floral anatomy of *Apocynum* in particular, have taught.

The anatomy and probable significance of the calycine appendages have been elaborated in some detail in previous paragraphs. However, it might be appropriate to add in this place reasons accounting for the existence of staminal vestiges *outside* the gamopetalous corolla. If gamopetaly is considered as an adaptation from polypetaly, and there are few indeed who do not accept such an interpretation, we have in the five-lobed corolla of the Apocynaceae the homologue of five individual petals. Within such a polypetalous flower, let us conjecture an androecium of two or more cycles of fives surrounding the partially inferior, bicarpellate gynoecium. Such a flower is more or less typical of the polypetalous Saxifragaceae. In the Saxifragaceae, moreover, the outer cycle of stamens, alternating with the petals, frequently becomes adnate to the tube of the calyx. In such a case, if the outer cycle of stamens should become sterile during the process of centripetal sterilization, a very common occurrence, the assumption of gamopetaly by the corolla would certainly exclude the staminal vestiges from the confines of the corolla in what might be considered a manner precisely similar to the exclusion of the calycine squamellae by the gamopetalous corolla of the Apocynaceae.

On the other hand, let us imagine the remote ancestors of the Apocynaceae, as many another angiosperm, as possessing no sharply defined corolla, but only a many-seriate androecium illustrating centripetal sterilization, as in the flowers of *Mentzelia*,

etc. In such a flower could it not be conceived that very extreme sterilization, adnation, and finally coalescence could produce such a flower as that of *Nerium:* the squamellae (which in teratology develop into two to several flanged petals similar to those of the gamopetalous corolla) representing the outer cycles of the androecium which have become extinguished due to the infinite continuation of centripetal sterilization and adnation to the calyx-tube; the gamopetalous corolla representing an inner cycle of sterilized micro-sporophylls which have coalesced; and the cycle of highly evolved and largely sterile stamens representing the innermost and last cycle of the once many-seriate androecium? Such an explanation of the condition of the single flower of *Nerium* is forcibly suggested by the appearance of the adenopetalous, or double, flowers, where the adenopetaly is frequently accompanied by dialysis of the gamopetalous corolla.

From what has been explained concerning the anatomy and histology of the Apocynaceae in the foregoing paragraphs, we find that (1) the ovary of the Apocynaceae is not superior, but "semi-inferior," as in certain families of the Rosales, especially the Saxifragaceae; (2) therefore the stamens should be considered as perigynous, and in young stages they are practically epigynous; (3) the ontogeny of such a flower as that of *Apocynum* indicates very clearly its progress from polypetaly in the late coalescence and adnation of floral parts; (4) pentacyclic gynoecia are present in the tribe Pleiocarpeae of the Plumeroideae; (5) although the theory of the calycine squamellae as staminal vestiges has not been absolutely proven, such an interpretation is both attractive and plausible.

In view of the preceding considerations, it appears rather unnecessary for Wernham to assign the ancestry of the Contortae to the "Geraniales-Sapindales plexus, and . . . no other." The Rosales, and in particular a more primitive condition of the present Saxifragaceous condition, provide a more accurate and a far more plausible affinity. Instead of appearing as a "gulf which at first sight appears difficult to bridge," the hypothetical connection between the Archichlamydeae and the Sympetalae *via* the Saxifragaceae- and Apocynaceae-plexus appears astonishingly close and clear. The relationships among the families of

Contortae are indeed fascinating, and it is intended that further studies will concern that problem.

In 1922 there appeared a very significant paper by Demeter[27] upon the morphology of the Asclepiadaceae. Although without the general consideration of the present studies, attention should be called to certain conclusions which were drawn. Briefly stated, the author found that the only real difference between the Apocynaceae and the Asclepiadaceae lies in the translators of the latter. The two families are also closest linked by the genera *Apocynum* and *Periploca* of either family through the pollen characteristics (persistent tetrads). Hence the author considered it proper to merge the two families into a single large group as Jussieu[28] conceived them. He also called attention to the fact that the tetradenous pollen of *Apocynum* forms a mass which may be transported in a single bulk of many tetrads by visiting insects, somewhat resembling the pollinia of the Asclepiads. Finally, the author reunites the two families and revises the bulk into three subfamilies: 1. *Apocyneae;* 2. *Periploceae* (including the genus *Apocynum*); and 3. *Asclepiadeae.*

Demeter's reasons for reuniting the Apocynaceae and the Asclepiadaceae are scarcely original. Adanson, Giseke, and A. - L. de Jussieu advanced very similar opinions in the early years of the nineteenth century. A. de Candolle[29] retained the separation by Brown, explaining that he did so although aware that the only clear-cut distinction is the organization of the pollen.

Like de Candolle, Baillon[30] also was forced to admit that: "Les Asclépiadées ont tous les caractères des Apocynées, sauf ceux de leur pollen qui est réuni en masse." However, as Garcin[31] states: " . . . nous ferons remarquer que toute une tribu d'Asclépiadées, les Périplocées, qui comprennent de nombreux genres, ont un pollen libre et forment ainsi une transition insensible aux Apocynées. D'autre part le *Vinca Rosea* a un pollen agglu-

[27] Demeter, K. Vergleichende Asclepiadeenstudien. Flora **115**: 130–176. 1922.

[28] Jussieu, Gen. Pl. 143–151. 1789.

[29] A. DC. Mémoire sur les Apocynées. Ann. Sci. Nat. Bot. III. **1**: 255–256. 1844.

[30] Baill. Traité de botanique médicale phanérogamique. 1277. 1884.

[31] Garcin, A. G. Recherches sur les Apocynées. Ann. Soc. Bot. Lyon **15**: 220–221. 1888.

tiné." The same author, moreover, found that the histology of the two groups is practically identical.

Although they certainly bear an extremely close affinity to one another, it is here considered better to continue the Apocynaceae and the Asclepiadaceae as separate families, even allowing the translator of the latter group, an extremely significant and specialized structure, to be the chief difference. However, the connection between the Apocynoideae and the Periplocoideae is unmistakable.

At the conclusion of this morphological and phylogenetical discussion, the writer takes particular pleasure in acknowledging his gratitude to Dr. A. J. Eames, of Cornell University, who read the manuscript and encouraged its publication.

THE GENERA OF APOCYNOIDEAE

Among the three genera of the subfamily Apocynoideae several significant and easily distinguishable indicators of phylogeny appear. Of these perhaps the most conspicuous, as well as one of the most significant, concerns the composition of the inflorescence. The inflorescence of *Apocynum* is a trichasium while that of *Poacynum* and *Trachomitum* is a monochasium. Phylogenetically, the trichasium is almost universally conceded to be a more primitive structure than the monochasium, and the justice of that view is shown by additional characteristics of the three genera.

The corollar appendages which have already been described with reference to *Apocynum* and *Nerium* are another source of valuable distinction. In the American genus *Apocynum*, as has already been explained, they are individual (*cf.* text-fig. 10, diagram 2*g*), while in the Eurasian genera *Poacynum* and *Trachomitum* they are coalesced into the form of a ring which appears more reduced in the former genus than in the latter (pl. 20).

An additional character of undoubted phylogenetic significance is the state of the nectaries, which are distinct and separate in *Apocynum* and *Trachomitum* and more or less coalesced into an annulus in *Poacynum*. Additional characters in the separation of the two latter genera are the tubular-campanulate corolla and opposite leaves of the former, and the pelviform corolla and alternate leaves of the latter.

KEY TO THE GENERA

Inflorescence trichasial; corollar appendages distinct and separate, not coalesced into a ring; corolla glabrous or very rarely irregularly hirtellous; auricles of the anthers parallel; genus of North America......I. Apocynum

Inflorescence monochasial; corollar appendages coalesced into a ring; corolla uniformly pulverulent-papillose without; auricles of the anthers convergent; genera of Eurasia.

Corolla tubulo-campanulate; nectaries distinct, not coalesced into a ring; pedicels single, not conspicuously paired; leaves opposite..II. Trachomitum

Corolla pelviform, without a definite tube; nectaries more or less coalesced into a fleshy annulus about the carpels; pedicels conspicuously paired; leaves alternate..III. Poacynum

Sufficient has been indicated of the relationship of the three genera of Apocynoideae in the preceding paragraphs; details concerning each will be reported in the revisions which follow.

SUMMARY

1. An historical account is given of the systematic arrangement of the Apocynaceous genera from the time of Tournefort to the present.

2. A new systematic arrangement of the family Apocynaceae is presented, based partially upon the system of K. Schumann in Engler & Prantl's 'Die natürlichen Pflanzenfamilien' and partially upon the results of original morphological investigations.

3. The genera *Apocynum*, *Trachomitum*, and *Poacynum* are segregated into a new subfamily based upon tetradenous pollen and an eglandular calyx.

4. The floral morphology and teratology of the genus *Nerium* are found to suggest explanations for several features of the floral organs of the Apocynaceae in general.

5. After a comparison of the calycine appendages or "squamellae" of representative Apocynaceae with the morphology and teratology of the single and double blossoms of *Nerium* it is conjectured that the calycine squamellae of numerous Apocynaceae may be interpreted as staminal vestiges which were excluded from the interior of the flower by gamopetaly.

6. The fleshy nectaries surrounding the carpels of numerous genera of all groups of Apocynaceae are perceived to be anatomically and ontogenetically similar to the carpels and are interpreted as a cycle of sterile carpels.

7. Close relationship of the Apocynaceae with the Saxifragaceae is indicated by (1) the bicarpellate and "semi-inferior" gynoecium; (2) the interpretation of the calycine squamellae as homologous to staminal whorls; (3) the polypetalous condition of very young flower-buds; and numerous other details of the morphology, anatomy and ontogeny.

8. Two recent and important treatises dealing with the phylogeny of the Apocynaceae are reviewed.

9. A key is provided to the genera of Apocynoideae, which are briefly described and contrasted.

II. A Monograph of the Genus Apocynum

INTRODUCTION

"When the Synoptical Flora, Vol. 2, part 1, was issued in 1878, only two species of *Apocynum* were recognized in North America, viz., *A. androsaemifolium* and *A. cannabinum*, and the distinction between them was none too marked. At the present time there are some thirty species recognized in North America, which as a rule are referred to one or the other of the two groups based on these original species. The result is that a sort of 'apocynal chaos' obtains such as we find existing in only too many of the so-called 'tough groups'." Thus the author[32] of a new species of *Apocynum* prefaces his description. Upon bringing his observations to a close, he further remarks in none too reassuring a vein: "The plant . . . cannot be referred to any recognized species, and as its characters are fully as distinctive as any of the genus, I have felt justified in proposing it as the type of a new species."

Since the time of the above writing, this "chaos" has become more and more perplexing, for in the period between 1910 and 1928 more than eighty additional North American species of *Apocynum* have been described, sixty of these having been proposed by the late Edward L. Greene. Beside these have accumulated many new varieties and forms. In spite of the many additions to the genus, however, many botanists still refer the various Apocyna to two or three species in identification, un-

[32] MacGregor, E. A. Bull. Torr. Bot. Club **37**: 261–262. 1910.

doubtedly because of the tenuous differentia to be encountered in an attempt to segregate them more accurately.

In 1913 a monograph of *Apocynum* was published by two Italian botanists,[33] which, however, for several cogent reasons is unsatisfactory to American botanists. In the first place, direct familiarity of the genus by the authors was confined to the few Eurasian representatives, constituting only about 10 per cent of the specific aggregate; knowledge concerning the North American species, constituting fully 90 per cent of the genus as conceived by the authors, was limited apparently to specimens borrowed from the United States National Herbarium. Secondly, analytical drawings are not present save for a very few of a general and elementary nature, which are diagrammatic to the point of obscuring morphological details of considerable importance. Thirdly, the citations of the authors are practically useless and frequently absolutely unintelligible,—evidently merely guesses of what the English inscriptions upon the labels of the American specimens might likely be, producing page upon page of what Prof. Fernald,[34] while referring to the paper in a recent review, has aptly called "Jabberwocky." All in all, the monograph is more of a curiosity than a scientific work.

The condition of the genus at the present time not only warrants another attempt at an adequate treatment of the group, but renders imperative a careful morphological study to substantiate the taxonomy of such a treatment. The present revision is an attempt to portray the evolutionary complexity of the genus as it appears to all who study it in the field, and at the same time to confine the specific concept applied to it within the bounds of practicality. To this end, extensive field studies have been made during five summers, embracing practically all of the species and varieties recognized. The collections of the genus in all the larger herbaria of the United States have been personally visited, and from several of the lesser herbaria abundant material for study has been borrowed through the courtesy of the various curators. Upon a smaller scale, breeding observations including both

[33] Béguinot, A., & Belosersky, N. Revisione monografica del genere Apocynum Linn. R. Accad. Lincei Atti, Mem. Cl. Sci. Fis. V. 9: 595–734. *12 pl. 12 figs.* 1913.

[34] Fernald, M. L. Science N. S. 68: 146. 1928.

Apocynum and the closely related genus *Trachomitum* have been undertaken in the experimental gardens and greenhouses of the Missouri Botanical Garden.

During the course of this study of the Apocynoideae, and in particular the genus *Apocynum*, two years were spent at the Missouri Botanical Garden, and one year at the Gray Herbarium of Harvard University. For the use of the herbarium, library, and laboratory facilities, as well as for the other conveniences of the Missouri Botanical Garden, the author is indebted to Dr. George T. Moore, the Director of the Garden. For the use of the excellent facilities for study at the Gray Herbarium, as well as for valuable advice and innumerable courtesies, he is likewise happy to acknowledge his obligations to Dr. B. L. Robinson, Curator of the Gray Herbarium, and also to the other members of the staff of that institution, particularly Prof. M. L. Fernald, and Dr. I. M. Johnston.

In connection with his visits to various herbaria of the country, the author desires to acknowledge the courtesy and hospitality of Dr. N. L. Britton, Dr. P. A. Rydberg, and Mr. Percy Wilson, of the New York Botanical Garden; Dr. F. W. Pennell, of the Philadelphia Academy of Natural Sciences; Dr. W. A. Maxon, Mr. T. H. Kearney, and Mr. E. P. Killip, of the United States National Herbarium; Dr. J. A. Nieuwland, in charge of the herbarium of Dr. Edward L. Greene at the University of Notre Dame; and Messrs. P. C. Standley and J. F. Macbride, of the herbarium of the Field Museum.

For the use of borrowed specimens of the genus *Apocynum*, the author is indebted to Dr. P. A. Munz, of the herbarium of Pomona College, to Prof. Harold St. John, of the State College of Washington, and to Mr. C. C. Deam, of Bluffton, Indiana, whose unexcelled private collection of Indiana plants proved an invaluable addition to the specimens of the various endowed institutions.

In the course of study of such a problem, material aid is frequently given by numerous friends, and for much assistance in the prosecution of these studies the author desires to thank the following: Dr. Edgar Anderson, Dr. D. H. Linder, Miss Nell Horner, Mr. Julian A. Steyermark, and Mr. Harry Fuller, of the Missouri Botanical Garden; Mr. Harry Piers, of the Provincial

Museum of Halifax, Nova Scotia; Mr. W. E. Saunders, of London, Ontario; and his father, Mr. Robert E. Woodson, Sr.

Finally, the author wishes to express his gratitude for aid and courteous criticism to Dr. J. M. Greenman, Curator of the herbarium of the Missouri Botanical Garden.

HISTORY OF THE GENUS

It is generally admitted that Dioscorides was the originator of the name *Apocynum*, and the purgative potentialities of the 'Απόκυνον, as his Greek original existed, were fully known to him. The medicinal use of the rhizomes of the plant were also appreciated by Pliny and Galen, who derived the word *Apocynum* from the Greek. The plant was so named from a composition of the Greek words ἀπό, *from, far from,* hence meaning "*bane,*" and κυνός, *of a dog,* implying the use of a decoction of the plant as a poison for wild dogs and other animal pests.

The identity of the plants called 'Απόκυνον by Dioscorides, and *Apocynum* by Pliny and Galen, as true Apocyna in the modern sense, however, has been brought into question by some antiquarians,[35] who contend that the plants mentioned by the ancient writers were more likely referable to the genera *Cynanchum* and *Marsdenia*, both members of the Asclepiadaceae occurring in Mediterranean, Adriatic, and Aegean lands. Sibthorp[36] upholds such a view, and confidently refers the Apocyna of the ancients to *Cynanchum erectum* L.

Recently the late Dr. Lunell,[37] pursuing his views of absolute priority, has changed the name of the North American Apocyna to *Cynopaema*, upon the testimony of Sibthorp that the *Apocynum* of the ancients was in fact *Cynanchum*.

Although the name *Apocynum* appears consistently throughout the herbals from the time of Pliny to the middle of the seventeenth century, no direct proof that the name was then applied to a rightful member of that present genus can be found until 1669, when Robert Morison's 'Praeludia Botanica'[38] appeared with the

[35] cf. Bartolozzi, F. Memoria . . . sopra le qualitá che hanno i fiori della piante, &c. in Opusc. scelt. sulle scienze e sulla arti. p. 293, Milano, 1779.

[36] Sibthorp, J. & Smith, J. E. Flora Graeca 1: 178. 1806.

[37] Lunell, J. Am. Mid. Nat. 4: 508. 1916.

[38] Morison, R. Prael. Bot. 12. 1669.

first recognizable plate of that genus and with polynomial phrases which describe the plants fairly well for the first time. Seven Apocyna were listed and illustrated by Morison as representing all of the species known to him. With the aid of his plates and polynomials, it is fairly safe to state that of these seven various so-called Apocyna, three were undoubtedly true members of that present genus, and that all three were natives of North America. Thus, as early as 1669 the American element of that genus was evidently the one associated with the name *Apocynum*. This is accentuated by the fact that the Linnaean *Apocynum venetum*, taken by some to be the type species of the genus, was yet included in the same work as "*Tithymalus maritimus, venetus*, . ." The three plants of Morison, taken to be referable to North American species of the present genus *Apocynum*, are his "Apocynum Canadense foliis Androsaemi," "Apocynum Canadense angustifolium flo. aureo," and "Apocynum Canadense angustifolium maximum flore minimo herbaceo." After each of these phrase names, the sign ƏG appears, denoting that the combination had originated with Morison himself.

Tournefort,[39] in 1700, provided *Apocynum* the most competent treatment with which it had ever before been accorded. He recognized in his generic description two main divisions, the first coinciding well with our present genus *Apocynum*, and the second equally well with the existing genus *Asclepias* and its immediately neighboring genera. This was the first well-defined break in the solidity of the great amorphous aggregate then called by the name *Apocynum*. Tournefort made the distinction of his unnamed divisions still more evident by referring each to a well-prepared analytical plate, presenting in themselves indisputable evidence of their individuality.

In Tournefort's treatment of the genus for the first time appears the European element of the Linnaean genus *Apocynum*, *A. venetum* L. as "*Apocynum maritimum*, Venetum, Salicis foliis, siliqua longissima." Preceding the "*Apocynum maritimum*, . . .", however, appear *Apocynum cannabinum* L. as "*Apocynum Virginianum*, flore herbaceo, siliqua longissima," and *A. androsaemifolium* L. as "*Apocynum Indicum*, foliis Androsaemi majoris,

[39] Tourn. Inst. 2: 91–94. 1700.

flore Lilii Convallium serrarubentis," implying that the author was more familiar with the two preceding than with the following "*Apocynum maritimum*, . . ." and desired the reader to be conscious of that fact.

The fifth edition of Linnaeus' 'Genera Plantarum'[40] was no improvement over Tournefort's 'Institutiones,' as far as the genus *Apocynum* is concerned. Although restricting the genus within smaller bounds than had Tournefort, the group was scarcely more homogeneous. Linnaeus' 'Species Plantarum'[41] recognized five species of *Apocynum*, as follows: (1) *A. fol. androsaemi*,[42] (2) *A. cannabinum*, (3) *A. venetum*, (4) *A. frutescens*, and (5) *A. reticulatum*. The first three species have remained until now as the traditional species of the genus, while the fourth and fifth have been transferred to other genera.

It is not thought expedient here to devote further space to the history of the specific concept of the genus *Apocynum*. Suffice to limit the present remarks to less obvious features of the problem. In 1748 Heister[43] listed during the course of a synopsis the genus *Apocynastrum*, corresponding to the "Apocynum Canadense foliis Androsaemi" of Morison; separating it from the typical *Apocynum* as represented by Morison's "Apocynum Canadense angustifolium flo. aureo." Fabricius[44] in 1759 retained and amplified the description of *Apocynastrum*, although he referred no species to it. Jussieu[45] in 1789 altered the name of the genus to *Apocinum*, without transferring any species to the new generic spelling.

Reference has already been made to the work of Robert Brown, which did so much to clarify the specific complex of the genus

[40] Linnaeus, Gen. Pl. ed. 5. 101. 1754.

[41] Linnaeus, Sp. Pl. ed. 1. 1: 213. 1753.

[42] It is a little-appreciated fact that the first edition of the 'Species Plantarum' published the familiar species of eastern North America as "*Apocynum fol. androsaemi*," and not as "*Apocynum androsaemifolium*," which appeared in L. Sp. Pl. ed. 2. 1: 311. 1762; and several floras, overlooking this, have referred to the species as "*Apocynum androsaemifolium* L. Sp. Pl. 1: 213. 1753." This latter familiar form is used throughout this monograph, although the rights of the former are duly acknowledged.

[43] Heistr. Syst. Pl. Gen. 8. 1748.

[44] Fabric. Enum. Meth. Pl. 256. 1759.

[45] Juss. Gen. Pl. 146. 1789.

Apocynum. Since the time of Linnaeus, species had been relegated to the genus carelessly and volubly, until a confusion had resulted which only the understanding of genius could clarify. The classic work of Brown[46] in ordering the chaos into two well-defined families, and finally into properly proportioned genera, will remain a monument for generations to come.

Alphonse de Candolle[47] accepted the conclusions of Brown in his synopsis of the genus in the 'Prodromus,' and his revision remained the last until 1913 when the monograph by Béguinot and Belosersky appeared, to which reference has previously been made.

Between 1844 and 1913, the only notable event in the history of the genus was in 1888, when Baillon,[48] after a study of the peculiar Asiatic element of the genus, segregated it from the mother genus, giving it for a name the anagram *Poacynum.*

GENERAL MORPHOLOGY

Roots.—The root system of all species of the genus *Apocynum* is extensive, filling the soil to a depth of three to four feet.[49] The root system is dual, comprising purely absorptive roots which are relatively fine and fibrous, ramifying the soil in the usual manner; and so-called "gemmiferous" roots, which are relatively stout and woody and assume a more or less horizontal position, presenting the general appearance of a rhizome. Plate 5, fig. 4, illustrates the subterranean axes of *Apocynum cannabinum.* As indicated in the figure, the fibrous absorptive roots (*f*) are produced freely along both the vertical rhizome (*a*) and the horizontal gemmiferous root (*e*), but principally upon the latter. The gemmiferous roots produce lateral buds (*c*) which at length develop into new vertical rhizomes. These new rhizomes are typical root-shoots,[50] such as those occurring in many arboreal genera as *Populus* and *Robinia,* and correspond to the "additional root-

[46] R. Br. *l. c.* 67–68. 1809.
[47] A. DC. in DC. Prodr. **8**: 439–440. 1844.
[48] Baill. Bull. Soc. Linn. Paris **1**: 757. 1888.
[49] cf. Weaver, J. E. Root development of field crops. pp. 83–84. *fig. 28.* 1926.
[50] Holm, Theo. On the development of buds upon roots and leaves. Ann. Bot. **39**: 867–881. 1925.

shoots" of Wittrock.[51] The young gemmiferous roots (*d*) are in turn produced laterally from the vertical rhizomes.

A fully mature gemmiferous root of *A. cannabinum* is usually .5–1.0 cm. in diameter, and may be several meters in length, giving rise to a dozen or more root shoots at one time. A single well-developed plant in a cultivated field may become spread by the plow-share to form colonies all over the field, the blade cutting the gemmiferous root into pieces and forming a new plant at each lateral bud. In this manner *A. cannabinum* and its varieties, especially, have become common pests of agriculture.

Plate 8 consists of two photographs of *A. medium* var. *lividum* growing in a cultivated field near Bayfield, Colorado. The photographs are unfortunately rather insufficient in detail, since an attempt was made to include as much in the plate as possible. Immediately adjoining the areas photographed were several areas of equal or greater extent. The part which vegetative propagation has played in obtaining the infested condition of the field may be appreciated when it is understood that the variety in question is evidently absolutely sterile, since no fruiting specimens have ever been found either in herbaria or in the field. The field photographed was visited in July, at which time not a single follicle or any indication of one, either young or of previous years, was found by the writer among the several thousand plants which infested it (see also p. 72). *A. androsaemifolium* and its near relatives, although possessing the same general form of rhizome and gemmiferous root, are more frequently found in woodlands, and are much less apt to invade cultivated land than *A. cannabinum* or *A. medium.*

A cross-section of a young absorptive root of *A. hypericifolium* is presented in pl. 4, fig. 1. The epidermis (*a*) is seen to consist of a single row of cells, from which numerous root hairs are produced. Within the epidermis lies an extensive cortex (*b*) consisting of about ten rows of rather spongy parenchymatous cells. In the center of the section, and occupying about one-third of the diameter, is found the stele, bounded by a rather poorly defined endodermis (*c*). The vascular structure is tetrarch in all of the

[51] Wittrock, V. Br. Om rotskott hos örtartade växter, med särskild hänsyn till deras olika biologiska betydelse. Bot. Notis. **1884**: 21. 1884.

cases examined, but has been found in a single instance to be pentarch. The four alternating masses of phloem (*e*) and xylem (*d*) are embedded in a conspicuous pericycle (*f*) composed of small and closely packed parenchyma. Larger and more loosely arranged parenchymatous elements occupy the center of the stele, and may be regarded as an elementary pith.

A sector of a cross-section of a fully mature gemmiferous root is presented in pl. 4, fig. 2. The secondary structure in such a root is very conspicuous. The epidermal cells have ceased to exist as such, and constitute a dead outer sheath, beneath which is a conspicuous periderm. The periderm consists of a several-layered phellem (*a*), a conspicuous and active phellogen (*b*), and a relatively inconspicuous phelloderm (*c*). Within the periderm lies an extensive cortical zone (*f*), traversed by latex tubes (*h*). The cells of the cortex contain much storage starch, which will be separately considered subsequently. Within the cortex lies a broad cylinder representing a coincidence of secondary phloem and pericycle. Isolated areas of crushed and half-absorbed cells are conspicuous, which are thought to be the remains of the primary phloem and endodermis. A functional endodermis is evidently lacking.

Occupying the interior of the stele is a broad cylinder of secondary xylem (*d*), composed of parenchyma and conspicuous and very numerous vessels. Traversing the xylem are found conspicuous storage rays (*l*) which extend through the phloem and cortex to the vicinity of lenticels (*k*) in the bark. A well-defined and active cambium (*g*) separates the phloem and the xylem.

Stem.—The stem system of the genus *Apocynum*, like the root system, is dual, comprising a more or less upright aërial stem and a vertical subterranean rhizome, passing reference to which has already been made in the preceding paragraphs with regard to the root system.

The rhizome appears to be developed almost entirely from the hypocotyl, in plants propagated from seed, stem-buds appearing upon that axis either laterally or in the axils of the cotyledons. In producing lateral stem-buds upon the hypocotyl, which in seedlings of all herbaceous Apocynaceae is a very conspicuous organ, the genus *Apocynum* differs from the genera *Amsonia* and

Rhazya, and is similar to the nearly related genus *Trachomitum*. The rhizome may be regarded as merely an underground portion of the true aërial stem, with which it is more or less perfectly confluent, the foliage leaves of the aërial portion grading uninterruptedly to the inconspicuous cataphylls of the rhizome. Since *Apocynum* is a north temperate genus, the chief distinction between the proper stem and the rhizome is that the former is annual, while the latter is perennial. The first aërial stem of a young rhizome is terminal, but following ones, appearing after the destruction of the first, are always lateral. Since the internal anatomy of both rhizome and aërial stem is fundamentally identical, as we shall presently see, the differences between rhizome and stem are general habit and longevity, production of roots by the rhizome, and the production of foliage leaves by the stem. An important additional difference is the method of branching, which is according to a definite plan in the stem, unlike the rhizome in which branching is evidently haphazard.

Taxonomically and phylogenetically the stem of the various species of *Apocynum* offers characters of considerable value. The stem of *A. androsaemifolium* and *A. pumilum* and their varieties has a relatively lax, spreading habit, and the branches are preponderantly alternate. The stem of *A. cannabinum* and its allied species and varieties differs in its opposite or sub-opposite, somewhat fastigiate branching, and is chiefly erect in habit. The intermediate character of *A. medium* and its varieties is noticeable in the mode of branching, which is intermediate between that of *A. androsaemifolium* and *A. cannabinum*. The branching is alternate to subalternate by the abortion or deferred development of an opposite axillary bud. The habit is also intermediate, since, although it is erect and not lax as in *A. androsaemifolium*, it has not the fastigiate appearance of *A. cannabinum*.

Ecological conditions easily influence the height of the stem. Plants of *A. pumilum* may be only two or three centimeters in height when growing at very high altitudes. A plant of *A. androsaemifolium* growing in an exposed, dry or sandy environment may produce stems only a few centimeters tall; while a plant of the same species growing in a shady, moist woodland may exceed a meter in height. Although in every other respect quite typical,

unusual developments of the stem due to ecological conditions have frequently been described as new species.

The anatomy of the stem and rhizome presents interesting features for study. Although a detailed account of the developmental anatomy is without the scope of the present paper, it is thought that a general account of the cellular constitution may be helpful in securing a relatively broad conception of the genus.

Plate 5, figs. 1–2, represent sectors of cross-sections of the stem of *A. cannabinum* and *A. androsaemifolium,* respectively, the former at a somewhat earlier development than the latter. In both certain anatomical characteristics are conspicuous. The epidermis proper (*a*) consists of a single layer of cells in which stomata are occasionally to be found. Immediately beneath the epidermis is a hypodermis (*b*) composed of cells somewhat similar to those of the epidermis, but appearing laterally more compressed.

The cortex (*c*) is extensive, occupying from approximately one-eighth to one-third of the cross section. The cells of the cortex are characteristically spongy and parenchymatous; and contain resinous secretions occasionally, and stored starch grains almost invariably.

A cross-section of the stem stained with a combination of safranin and *licht gruen* or gentian violet detects the presence of starch in the cortex. The individual grains are roughly elliptical-discoid in shape, with a conspicuous and highly refractive hilum. Conspicuous and irregular fissures in the hila are almost always perceptible. Illustrations of the included starch from the cortex of *A. cannabinum* are presented in pl. 5, fig. 5. Within the cortex proper the collenchyma differs from the strictly parenchyma by a lack or paucity of included starch.

Within the cortex the pericycle (*j*) appears as prominent and isolated groups of fibers of great length and strength, the use of which by the aborigines of North America as a constituent of rope and thread has caused the popular name "Indian Hemp" to be given *A. cannabinum.* Associated with the pericyclic fibers are groups of latex tubes.

The family Apocynaceae shares with other families of the order Contortae a bicollateral development of the stele. In the genus *Apocynum* the intraxylary phloem forms a conspicuous vascular

feature. The external phloem (*e*) forms a more or less continuous cylinder within the pericycle, and consists largely of fibrous elements. The irregular masses of pericycle, however, sometimes invade the zone of phloem, causing its disruption into discontinuous segments (fig. 2*j*).

The xylem (*g*) consists of a continuous hollow cylinder enclosing the internal phloem and pith. The woody elements are conspicuous and relatively few-angled. Vessels are not as numerous or as conspicuous as in the gemmiferous roots. The woody cylinder becomes greatly enlarged during the period of growth of the stem. In the young stem represented by fig. 1, the diameter is approximately 1 mm. and there are about seven rows of cells in the xylem. In a stem of about 1 cc. in diameter, the rows of xylem cells number about one hundred.

The internal phloem (*f*) in the genus *Apocynum* forms a rather loose, interrupted cylinder, separated from the xylem by a row or two of parenchymatous cells. The elements of the internal phloem are more parenchymatous than those of the external phloem.

The origin of the internal phloem in dicotyledons has been a disputable subject. According to Scott and Brebner,[52] who devoted extensive research to the question, the internal phloem arises from the procambium. On the other hand, Hérail[53] and Lamounette[54] are of the opinion that the internal phloem originates from the pith. In the course of the present studies it was not considered feasible to investigate this technical problem. The author, however, is inclined to accept the view of Scott and Brebner. The reader is referred to the literature.

The center of the stele is invariably occupied by a conspicuous pith (*h*). In young stems certain cells display included starch grains (fig. 1*i*), but that condition is rather rare. Frequently isolated latex tubes (*m*) appear in the region of the pith bordering the internal phloem.

[52] Scott, D. H., & Brebner, G. On internal phloem in the root and stem of dicotyledons. Ann. Bot. **5**: 259–300. *pl. 18–20.* 1891.

[53] Hérail, J. Étude de la tige des dicotylédones. Ann. Sci. Nat. Bot. VII. **2**: 267. 1885.

[54] Lamounette, B. Recherches sur l'origine morphologique du liber interne. Ann. Sci. Nat. Bot. VII, **11**: 193–282. 1890.

The internal anatomical structure of the rhizome (pl. 5, fig. 3) is practically identical with that of the stem, differing chiefly in the possession of a distinct periderm (*b*), and conspicuous vascular rays (*k*). The vessels of the metaxylem of both the rhizome and the stem contain many-seriate, alternate bordered pits, closely pressed together and thus assuming a roughly hexagonal outline. Plate 4, fig. 6, illustrates the pitting of a tracheid of secondary xylem of *A. cannabinum.*

According to Scott and Brebner[55] internal centripetal wood occurs in the stem of *A. cannabinum,* associated with the internal phloem. According to those authors internal cambium makes its appearance all around the pith, forming on its outer margin fresh cells of internal phloem, and on its inner isolated masses of xylem amounting to a maximum of twenty-five elements, equal to about one-eighth of the normal wood. No internal wood was discovered in the stems of *Apocynum* which were studied in the course of this study. This failure may be accounted for by the fact that Scott and Brebner examined wood of greater diameter than that studied by the present writer. Another source of error may be fluctuation of this phenomenon.

The interpretation of the horizontal subterranean axis of the genus *Apocynum* as a gemmiferous root rather than as a horizontal rhizome is not of very common occurrence. Even anatomical studies have occasionally identified that axis as a rhizome.[56] From the stem and rhizome, however, the gemmiferous root differs in several conspicuous and concise anatomical features. As will be seen from a comparison of pl. 5, figs. 1–3, and pl. 4, fig. 2, the stem and the rhizome possess pericyclic fibers, internal phloem, and central pith, as well as resinous cortical cells, which the gemmiferous root does not. The latex tubes of the stem and rhizome occur in association with the pericycle, whereas those of the gemmiferous root occur in the cortex. In addition, the xylem of the gemmiferous root differs from that of the stem and the rhizome in the greater size and number of vessels and the more parenchymatous nature of the cells.

[55] Scott, D. H., & Brebner, G. *l. c.* 283–285. *pl. 19, figs. 13–14.* 1891.

[56] *cf.* Garcin, A. G. Recherches sur les Apocynées. Ann. Soc. Bot. Lyon **15:** 210–221. 1888.

Leaves.—The leaves of the genus *Apocynum* are opposite, membranaceous, entire, and either distinctly petiolate or sessile. Superficially they may be either glabrous or variously pubescent. The outline and surface of the leaves are extremely polymorphic, which fact has been the cause of much of the taxonomic confusion regarding the specific complex of the genus. Leaf size, shape, and pubescence or glabrity are characters evidently to be considered with caution. Two foliar characters are evidently reliable, however. These characters are the relative shape upon the primary axis of the plant, and the position which the leaf takes with regard to the axis of the stem.

Illustrating the former category, it can be shown that the majority of the species possess leaves which are nearly uniform throughout the plant, at least in shape; while others, as *A. hypericifolium* and its varieties, have leaves which are relatively broad, blunt, sessile, and cordate or amplexicaul upon the primary axis, while those upon the secondary axes may be petiolate and relatively narrow, giving the plant a somewhat heterophyllous foliage.

The second category is illustrated by the leaves of *A. androsaemifolium* and its allies, which are drooping and somewhat pendulous; by those of *A. medium* and its allies, which spread at nearly right angles to the axis of the stem; and by those of *A. cannabinum* and its allies, which ascend from the main axis.

Connecting the base of the petioles of each pair of leaves occurs an inconspicuous ring of triangular, membranaceous, pectinate glands 1 mm. or less in greatest dimension. These appendages are superficial in origin, and whatever their origin or function is difficult to determine, since they present no distinct anatomical clue to their identity. They are probably best regarded as Lindley[57] regarded them, as vestiges of stipules, for a critical examination of them shows that they are connected by a shallow annular lamina.

In studying the morphology and anatomy of the foliage of *Apocynum*, *A. androsaemifolium* and *A. cannabinum* were selected

[57] Lindley, J. Nat. Syst. ed. 2. 300. 1836. Lindley regarded the stipular glands which he observed in several genera of the Echitoideae as evidence of relationship with his family Cinchoniaceae, the stipules of which are conspicuous.

as contrasting objectives. Representative sectors of cross-sections of leaves of either species are represented in pl. 6, figs. 5 and 4, respectively. The leaf in either case is a typical dorsiventral mesophyll.

The epidermal layers consist of only one layer, in either case, and are composed of relatively even and regular cells upon the upper surface (*a*), and relatively irregular and loose cells upon the lower surface (*b*). The mesophyll of either species is highly developed. In *A. cannabinum* (fig. 4) the ratio of palisade to spongy parenchyma is about 3 : 2. The palisade cells (*c*) in that species are rather compact oblong-ovoid cells, and are arranged in two to several layers. The spongy parenchyma (*d*) is composed of larger, flabby cells, rather distantly and irregularly arranged, forming numerous air-chambers.

The ratio of palisade to spongy parenchyma in leaves of *A. androsaemifolium* is rather higher, about 3 : 1. The palisade cells (*c*) are more uniform than in the preceding species, in shape, size, and arrangement, constituting a single layer of cells. The spongy parenchymatous cells (*d*) are similar to those of *A. cannabinum.*

The difference in the number of layers of palisade cells between *A. androsaemifolium* and *A. cannabinum*, noted in the preceding paragraph, forms a tangible and evidently constant internal distinction between the two species. The number of layers is not dependent upon ecological conditions, as experiment has proven. Both in the studies of Mrs. Clements[58] with the former species, and of those of the present investigation with the allied species of the genus, the number of layers of palisade cells has appeared constant. In the species intermediate between *A. androsaemifolium* and *A. cannabinum* the layers of palisade cells vary from one to several.

Evidently stomata occur only on the lower surface of the foliage. These organs are most frequently accompanied by two or more subsidiary cells which are placed parallel to the pore, simulating the "Rubiaceous type" of Solereder.[59]

[58] Clements, E. S. The relation of leaf-structure to physical factors. Trans. Am. Microsc. Soc. **26**: 19–102. *9 pls.* 1905.

[59] Solereder, H. Syst. Anat. Dicotyledonen. 911. 1899.

In the leaf laticiferous tubes occur only in the veins, and in no case were they observed among the cells of the parenchyma.

Inflorescence.—The inflorescence of *Apocynum* is a trichasial cyme, varying greatly in size, shape, and construction. A cyme may produce but one to four flowers in some cases, while in others the flowers may be extremely numerous. In certain species, as in *A. cannabinum*, where the inflorescence is usually dense, each

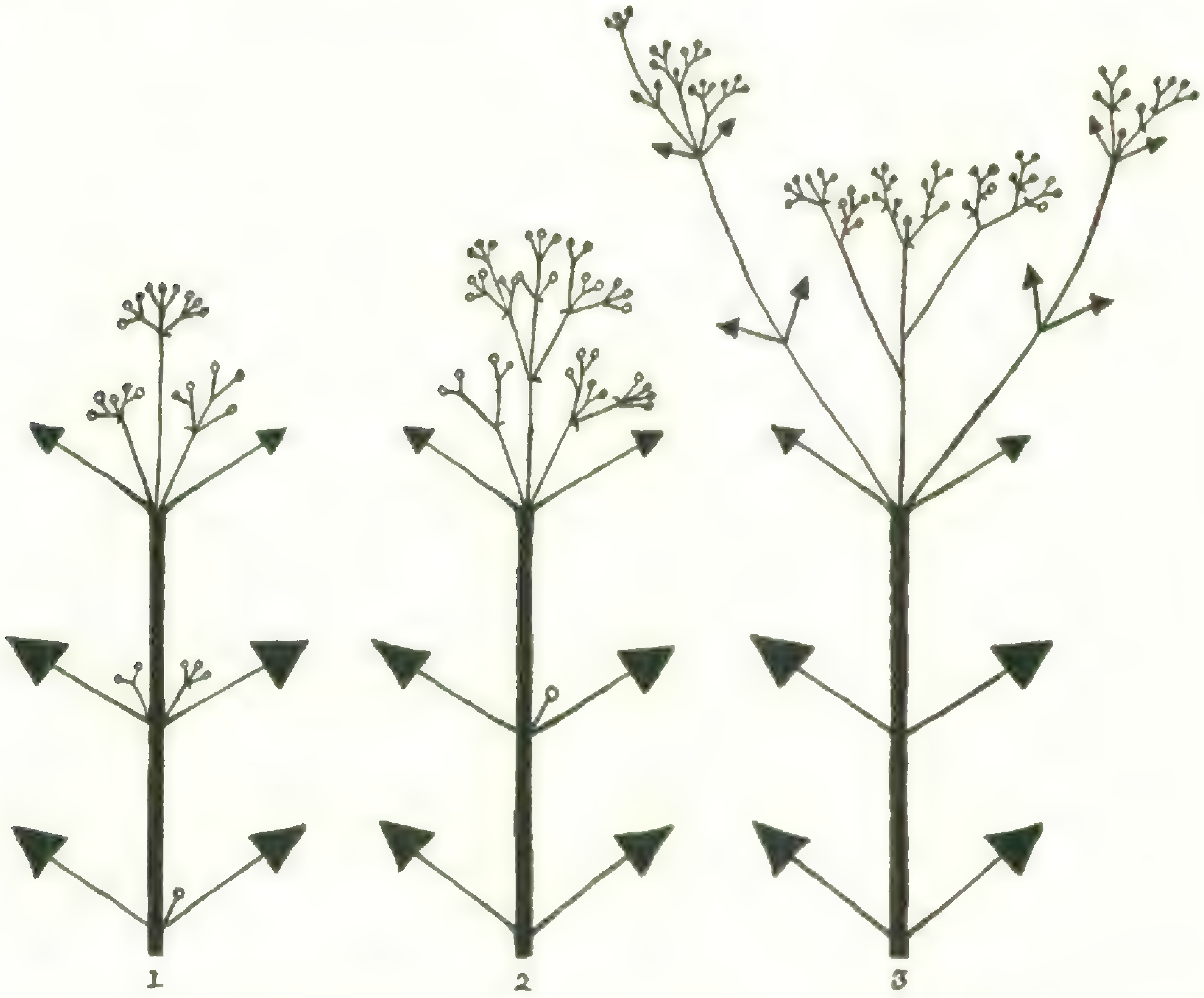

Fig. 9. Diagrams illustrating three characteristic inflorescences among species of the genus *Apocynum*: *1. A. pumilum; 2. A. androsaemifolium;* 3. *A. cannabinum.*

pedicel and peduncle is subtended by a distinct bract which may be scarious, as in *A. cannabinum* and its varieties, or semifoliaceous, as in *A. hypericifolium* and its varieties. In the case of others, as *A. androsaemifolium* and its allies, where the cymes are fewer-flowered, pedicellar bracts may be evident or virtually lacking.

Text-fig. 9 illustrates very diagrammatically the three most prominent forms of inflorescence from which all other forms in the genus appear to be derived. Diagram 1, representing the

inflorescence of *A. pumilum*, shows the inflorescence to be chiefly terminal, but evidently axillary also in decreasing quantities along the upper nodes of the stem, receding from a multiparous cyme, usually composed of three fully developed cymes, to uniparous axillary cymes in the axils of the upper leaves (which are usually somewhat reduced in size), and finally to single axillary flowers subtended by leaves of normal size.

The first diagram demonstrates that the central cyme of the pleiochasium is the most extensive and perfect in form, branching regularly and determinately. The ventral terminal branches, however, are less extensive, and evidently less regular than the dorsal, demonstrating a suppression of the determinate flower or cymule. Finally, the small axillary cymes are found to continue this suppression until the inflorescence is reduced to a single flower, and later disappears altogether.

Diagram 2, representing an inflorescence of *A. androsaemifolium*, illustrates the subsequent continuation of the tendencies noticed in the inflorescence of *A. pumilum.* The central cyme of the terminal pleiochasium is here also seen to be the most elaborate of the three branches of the trichasium, and nearer to the determinate type; but here, in its ramifications, is again noticed the suppression of the determinate member of the cyme, the central cymules being reduced as a rule to a single flower, and the central flower of the cymule frequently suppressed. The tendency toward the development of the paniculate type is shown by the two ventral cymes of the trichasium, where the determinate character has practically disappeared. Axillary flowers or cymules appear only abnormally.

Diagram 3 represents an inflorescence of *A. cannabinum*, where the tendencies noted in the preceding paragraphs find final amplification. Here the inflorescence has become a paniculate cyme, and axillary flowers are completely suppressed. The determinate character is also wanting, except theoretically in the triple multiplication of the terminal pleiochasium. Here also it is found that one of the lateral cymes of the trichasium, or not infrequently both of them, has acquired the power to continue vegetatively to form a new and complete stem with a terminal trichasium, and thus to continue and prolong the re-

productive potentialities of the plant. In this manner a plant of *A. cannabinum* and its allies may continue in bloom and vegetative growth from spring until late in the autumn, a distinct advantage over the much shorter periods of growth of the other species.

A condensed view of the tendencies of the inflorescences illustrated appears to be to regard the entire process as the building up of a compact, specialized form from a branch of axillary flowers through the reduction of foliage and the aggregation of flowers. From such a viewpoint, it would be reasonable to regard *A. pumilum*, with a nearly perfect determinate cyme and normal axillary flowers, as the most primitive of the types discussed; *A. androsaemifolium*, with a less determinate cyme and abnormal axillary flowers, and *A. hypericifolium*, with paniculate cymes, foliaceous bracts, and no axillary flowers, as intermediate types; and *A. cannabinum*, with a paniculate cyme, scarious bracts, and no axillary flowers, as the most advanced.

Flowers.—The floral anatomy of the genus *Apocynum* has already been described in some detail (pp. 25–30). In this section the separate organs will be discussed in a general manner, only.

The calyx of *Apocynum* is synsepalous. The five regular lobes are separate almost to the base, and may be greenish, reddish, or whitish in color, and pubescent or glabrous. It appears that the ecological situation of the plant has much to do with the pigmentation of the vegetative parts, including the calyx; an exposed sunny situation almost invariably imparting a ruddy tint to those parts.

The lobes of the calyx vary considerably in outline; and the margins are entire, save in one variety, *A. medium* var. *lividum*, where they are minutely laciniate or toothed.

The corolla is gamopetalous and regularly five-lobed. Contrary to the opinion of several students of the genus, the shape of the lobes appears of little taxonomic importance. The position of the lobe with reference to the corolla-tube, however, appears dependable. In *A. androsaemifolium* and its allies, the corolla-lobes are sharply recurved, differing distinctly from those of *A. cannabinum* and its allies, which are nearly, or quite, erect. The lobes of *A. medium* and its varieties add an additional inter-

mediate character to their striking affinities to both the androsaemifolioid and the cannabinoid groups by assuming a spreading position. The color of the corolla varies from greenish white to pinkish or purplish.

The relative length of the corolla and the calyx-lobes has proved to be an important taxonomic criterion. In *A. androsaemifolium* and its allies, the ratio of the length of the corolla (including both tube and lobes) to the length of the calyx lobes is at least 3 : 1. In *A. cannabinum* and its allies, the same organs have a ratio of less than 2 : 1, and the calyx-lobes usually equal the corolla in length. In *A. medium* and its varieties, the ratio of corolla to calyx-lobes is almost exactly 2 : 1. The comparative width of the corolla at base and orifice is an additional character which is frequently used. In *A. androsaemifolium*, the tube of the corolla dilates considerably, and the orifice is much wider than the base, producing a campanulate flower. In *A. pumilum*, the corolla is cylindrical, and the base and the orifice are nearly or quite equal. So also the corolla-tube of the typical variety of *A. hypericifolium* is somewhat campanulate, while that of *A. hypericifolium* var. *salignum* is nearly cylindrical. The corolla is preponderantly glabrous throughout the genus, but very rarely, as in *A. medium* vars. *sarniense* and *vestitum*, microscopic tufts of tomentum are developed upon the exterior.

The cellular constitution of the corolla is illustrated by a sector of a cross-section in pl. 6, fig. 1. As illustrated in the figure, the most characteristic feature of the corollar anatomy is the external epidermis of a single layer of bulbous, or papillate cells. It is a further elongation of these protuberant cells which causes the peculiar and characteristic pulverulent-papillate condition of the corollas of *Poacynum* and *Trachomitum*, as well as the microscopic tomentum of the corollas of *Apocynum medium* vars. *sarniense* and *vestitum*.

The mesophyll of the corolla is relatively thick, and is composed of large, irregular, loosely connected cells. Latex tubes are numerous, but do not appear to be associated with the conductive system as in the leaves and to some extent in the calyx-lobes. Fifteen vascular strands enter the corolla, after it is fully differentiated from the receptacle, assuming five groups of three

strands each. These vascular groups correspond to the lobes of the gamopetalous corolla, and are homologous to petals. In the neighborhood of the median vascular strand of each lobe, the cells of the mesophyll are smaller and more compact than elsewhere. This region is occupied by the peculiar corollar flanges characteristic of the genus. These flanges are composed of three internal ridges at the base of the corolla-tube which gradually converge into a tiny apiculate tip, forming a flat cordate-sagittate process about 2 mm. tall and 1.5 mm. broad, which alternates with the stamens, the apex fitting closely into the spaces between the auricles of the anthers. Conjectures concerning the significance of these corollar flanges were offered in a previous section of this study; their function will be discussed subsequently. Plate 6, fig. 1, illustrates the transverse constitution of the three corollar flanges at slightly different levels. Text-fig. 10, diagram 2 (*g*), presents their superficial habit.

The stamens are very highly developed, and sterilization of tissue is apparent. They are rather loosely attached to the base of the corolla-tube, alternating with the lobes. The filaments are short and thick, and frequently very pubescent. The anthers are introrse, connate, and appressed about the pistil in the form of what has been described as a "gynostegium" by Demeter,[60] who wished to emphasize an analogy with a somewhat similar condition in the Asclepiadaceae.

The anthers consist largely of a greatly elaborated, sterile, peltately affixed, narrowly sagittate connective, with a deeply auriculate base. The four small sporangia are borne above the insertion of the filament. The basal, or auriculate, half of the anther is completely sterile. At the maturity of the pollen, or shortly before, the partition between each of the dorsal and ventral loculae is ruptured, giving the appearance of a two-celled anther. Finally the ventral cells dehisce longitudinally and shed the pollen. The false bisporangia of *Apocynum* are characteristic of the genera of Apocynoideae, and appear to constitute an additional affinity with the Asclepiadaceae.

The pollen grains are relatively small (diam. about 10 μ), spherical, and smooth-walled. The pollen tetrads, as has already

[60] Demeter, K. *l. c.* 1922.

been explained, never normally separate into individual grains. The pollen of practically all the species of *Apocynum* is largely abortive, and polysporous tetrads are frequent, apparently indicating frequent hybridization.

Upon the receptacle are situated the two carpels comprising the ovary and the cycle of five fleshy nectaries which encircles them. The carpels are separate except by their common partial immersion in the receptacle, and at the tips, where they are united by a common fleshy style called the clavuncle. The clavuncle is thickened and truncate, and bears the terminal stigma. Plate 6, fig. 3, illustrates the cellular condition of a median longitudinal section of the clavuncle of *Apocynum androsaemifolium.* The organ should evidently be construed as the product of the fusion of two bodies representing the individual style and stigma of either of the two carpels, as the two vascular strands (the dorsal strands of either carpel) present in it are entirely separate, and the body cells themselves retain an individual appearance especially in the central region. The upper, or stigmatic surface of the clavuncle, is highly glandular, and secretes copiously.

During the earlier phases of the present study, the shape of the clavuncle of the various species of *Apocynum* was considered to be of taxonomic importance. Extensive studies of the clavuncle of all the described species and varieties were accordingly made. Many vials were filled with dissected clavuncles, and correctly labelled with the appropriate taxonomic designations. Microphotographs were also made in the hope that they would provide a concise criterion for differentiation. After several months of concentration upon that organ alone, however, the conclusion was reached that the clavuncle is apparently quite variable, and of doubtful taxonomic assistance. Other technical characters have likewise been exhaustively studied to aid in the delimitation of species, but their value has appeared so dubious that in the taxonomic treatment which follows, macroscopic characters have been employed in entirety. Dr. Ballard,[61] however, has employed the character of the clavuncle in providing a survey of the species of the eastern United States for pharmaceutical use.

[61] Ballard, C. W. Taxonomy and pharmacognosy of the genus Apocynum. Proc. Internat. Cong. Plant Sci. 2: 1406–1412. 1929.

Either carpel of the gynoecium contains a single loculus bearing numerous anatropous ovules upon an axile binate placenta. The placenta contains two main longitudinal vascular bundles from which the traces to the ovules depart.

A common misconception regarding the Apocynaceae is that the nectaries which frequently surround the carpels represent a "disc." Such, however, is not the case, unless the term "disc" is to become an entirely meaningless shibboleth. The nectaries, as has already been observed, are probably developments of a vestigial cycle of carpels. Detailed evidence has already been presented to support the assertion that they should be viewed

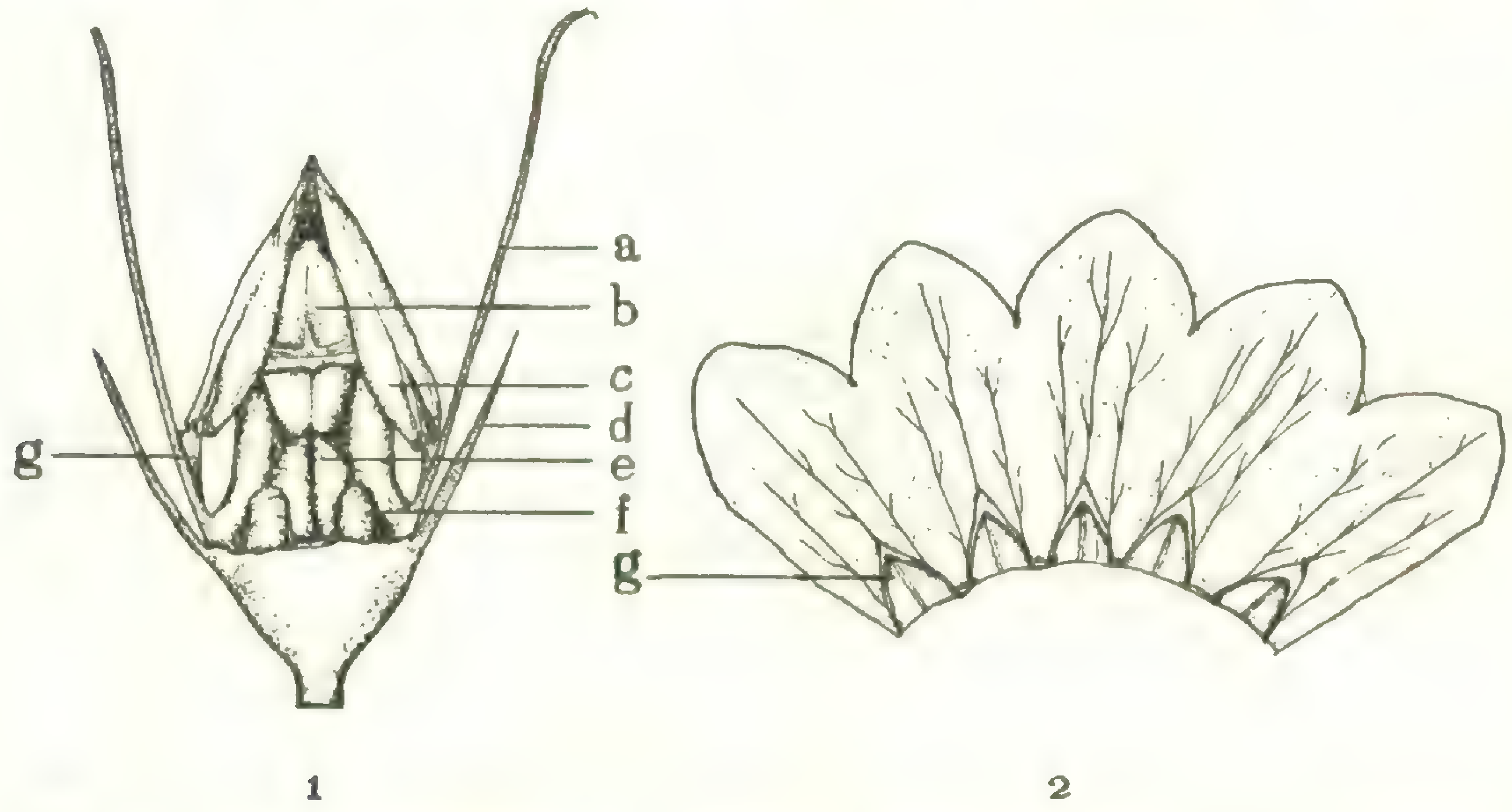

Fig. 10. Floral morphology of *Apocynum androsaemifolium*. 1: longitudinal view, with portion of corolla removed. *a*- corolla; *b*- clavuncle; *c*- stamen; *d*- calyx; *e*- ovary; *f*- nectary; *g*- corollar appendage. 2: interior of dissected corolla, indicating the corollar appendages, *g*.

as equivalent to a cycle of carpels. However, the nectaries occasionally demonstrate a coalescence with the receptacle (cf. *Odontadenia*), or even with the carpels (cf. *Tabernaemontana*), when their status naturally becomes obscure. Text-fig. 10 illustrates the organography of the flower of *A. androsaemifolium*.

Floral Mechanism.—The floral organs of the genus *Apocynum*, which have been separately described in the preceding paragraphs, compose a reproductive mechanism of extreme interest, but one which has never yet been satisfactorily explained.

As will be seen from a glance at text-fig, 10, diagram 1, the four

cycles of reproductive organs form an intricate and compact mass within the center of the perianth. Without careful dissection and keen observation the parts and composition of the complex mechanism are scarcely easy to comprehend. The center, of course, is the bicarpellary gynoecium (*e*) surmounted by the barrel-shaped clavuncle (*b*). As will be perceived from the diagram, the clavuncle is divided equatorially into an upper and a lower region. The upper region is slightly bilobate, and was considered by Linnaeus and Tournefort to bear the stigma.

Pressed tightly about the clavuncle and gynoecium is the cycle of five stamens (*c*) alternating with the ovoid nectaries (*f*) and the sagittate corollar appendages (*g*). The anther of the stamens is fertile only toward the apex (i. e., the portion adjacent to the upper half of the clavuncle). At the point of attachment of the filament to the anther, elongate glandular hairs arise from the epidermis and meet with similar epidermal outgrowths from the equatorial region of the clavuncle. These elongate cells secrete viscin, which binds the androecium to the gynoecium. So tightly are the two cycles of sex organs cemented by these epidermal appendages and their secretions that one can scarcely remove the stamens without dislodging the clavuncle from the apex of the carpels.

The true position of the stigmatic surface and the procedure of the pollination of *Apocynum* have been much and variously discussed. As has been stated above, the stigma was called terminal by Linnaeus and Tournefort, neither of whom attempted an explanation of its pollination. In 1759 Fabricius[62] wrote of the attraction which *A. androsaemifolium* exerts upon nectar-loving insects and observed that frequently the visitors are found trapped within the flower. In 1783 Lamarck[63] described the insect relations of the same species as follows:

> "The name *gobe-mouche* [fly-trap] has been given to it, because the flies, in their greed of the honeyed juice which is found at the bottom of its flowers, insinuate their proboscides by the narrow passage which is found between the small bodies [nectaries] which surround the ovaries, and the ovaries themselves, and when the insects would withdraw their proboscis, it is found to be held the faster, the more efforts they make to withdraw it. Thus these insects, half buried in the flowers, are caught as in a trap, and perish there without the power to escape."

[62] Fabric. Enum. Meth. Pl. 256. 1759.

[63] Lam. Encycl. 1: art. *Apocynum*. 1783.

In Europe, *A. androsaemifolium* was cultivated since early days, the exact date of its introduction being unknown.[64] However, by the last quarter of the eighteenth century it was evidently widely cultivated and viewed as a curiosity because of its propensity of capturing insects. In 1794 Moench[65] proposed the name *A. muscipulum* for *A. androsaemifolium.*

Although it is now fully understood that insects trapped in flowers of *Apocynum* are probably always detained by the viscous floral secretions, some fantastic explanations have been advanced. Lamarck[66] was of the impression that mechanical pressure exerted by the nectaries is responsible for detaining the proboscis. A somewhat more current view was that the anthers actually grasped the insect as do the leaves of *Dionaea.* Erasmus Darwin[67] appears to have been one of the first to sponsor this view, and wrote as follows:

> "In the Apocynum Androsaemifolium, one kind of Dogsbane, the anthers converge over the nectaries, which consist of five glandular oval corpuscles surrounding the germs; and at the same time admit air to the nectaries at the interstice between each anther. But when a fly inserts its proboscis between these anthers to plunder the honey, they converge closer, and with such violence as to detain the fly which thus generally perishes."

Although accounts of other authors regarding the muscipulous habit of *Apocynum* would not be suitable in this general account, the description of the plant by the anonymous author of 'The Journal of a Naturalist'[68] should be included as perhaps the most fabulous of all:

> "But we have one plant in our gardens, a native of North America, than which none can be more cruelly destructive of animal life, the dogsbane (apocynum androsaemifolium) which is generally conducive to the death of every fly that settles upon it. Allured by the honey on the nectary of the expanded blossom, the instant the trunk is protruded to feed on it, the filaments close, and catching the fly by the extremity of its proboscis, detain the poor prisoner writhing in protracted struggles until released by death, a death apparently occasioned by exhaustion alone; the filaments then relax, and the body falls to the ground. The plant will at times be dusky from the numbers of imprisoned wretches. This elastic action of the filaments may be conducive to the fertiliza-

[64] Ray (Hist. Pl. p. 1089) mentions "Apocynum flore Lilii convallium purpurascente" as appearing in the famous physic garden at Chelsea in 1688.

[65] Moench, Meth. 464. 1794.

[66] Lam. *l. c.* 1783.

[67] Darwin, E. The botanic garden. Part 2: The loves of the plants. 126. 1791.

[68] *Anon.* The journal of a naturalist. 80–81. 1829.

tion of the seed by scattering the pollen from the anthers, as is the case of the berberry; but we are not sensible, that the destruction of the creatures which excite the action is in any way essential to the wants or perfection of the plant, and our ignorance favours the idea of wanton cruelty in the herb; but how little of the causes and motives of action of created things do we know!"

This highly fictitious narrative is illustrated by a sketch showing the flower of *A. androsaemifolium* before: with outspread anthers awaiting the visit of the victim; and after: with the anthers pressed tightly about a fly.

Apparently the first man to interpret the visits of insects to *Apocynum* as a means of pollination was Bartolozzi,[69] who advanced the opinion that the visiting insects inject the proboscis between the connate mass of the clavuncle and anthers both to obtain the pollen and to apply the pollen to the stigma. The account of Bartolozzi regarding the insect visits and the morphology of the flower was an exceptionally full and accurate one for its day.

In 1809, as is well known, Robert Brown[70] described the stigmatic surface of *Asclepias* as occupying the lower portion of the stylar shaft, and succeeded in tracing pollen tubes from that organ to the placenta and ovule. Contemporaneous botanists were quick to accept Brown's observations, and in 1849 Schleiden[71] also drew the conclusion that the stigma of *Apocynum* is situated likewise on the basal half of the clavuncle.

In 1867 Delpino[72] largely recapitulated the conclusions of Bartolozzi, favoring the view that pollen is transmitted to the basal stigma by the efforts of the proboscis to reach the nectaries surrounding the ovary. During the years 1872–73 W. H. Leggett[73] became interested in the biology of *Apocynum*, devoting several short but highly interesting articles to the subject in the 'Bulletin of the Torrey Botanical Club.' Leggett followed Delpino's de-

[69] Bartolozzi, F. Memoria . . . sopra le qualitá che hanno i fiori della piante detta *Apocynum androsaemifolium* di prender le mosche, etc. Opusculi scelti sulle scienze e sulle arti. 193–200. 1779.

[70] Brown, R. Mem. Wern. Soc. 1: 12–18. 1809.

[71] Schleiden, M. J. Botanik. 494. 1849.

[72] Delpino, F. Sugli apparechi della fecondazione nelle piante antocarpee . . . 19–21. 1867.

[73] L[eggett], W. H. Bull. Torr. Bot. Club **3**: 46, 49–50, 53–55. 1872; **4**: 1–2, 23. 1873.

scription of the pollination of the genus, adding many original observations on the manner in which insects are frequently trapped within the flower.

The manner in which pollen can be transferred to the stigma by the proboscis is easily understood, but the method of acquiring the pollen itself is not so easy to explain, since the insects send the proboscis straight to the receptacle of the flower by way of the exterior of the stamens and not usually through the connate mass of the anthers. This was neatly explained by Leggett as follows:

> "The fly probably dips its head down to get at the nectaries in the bottom of the cup, and, in drawing it back, sometimes gets its proboscis caught in the groove between the anthers, to which it is guided by their diverging bases. As the proboscis is drawn up the groove, it passes the glutinous glands [i. e., the viscous secretions from the epithelial gland-hairs of the stamen and clavuncle], which are easily detached when the flower is mature, and, being thus charged with one or both of these glands, draws out the pollen from one or both of the adjacent anther cells. Perhaps alarmed by this rude entertainment, the insect flies off to a more distant flower, where it goes through the same process, first, however, leaving the stranger pollen on the stigmatic surface."

It is evident that all who have dealt with the subject have been put to some pains to explain the pollination of *Apocynum*. By no means a help to the situation is the reassignment of the stigmatic surface to the upper half of the clavuncle by Demeter,[74] who investigated the cellular constitution of that organ and found the typically stigmatic cells located in that position. Plate 6, fig. 3, represents a median longitudinal section of the clavuncle of *A. androsaemifolium*. It will be seen that the upper portion bears typically glandular stigmatic cells (*d*), while the lower region is scarcely equipped to carry on the function of a stigma. Pollen tubes have also been found by the writer to penetrate through the upper region of the clavuncle.

As all of the investigators dealing with the subject in recent years have believed, the flowers of *Apocynum* are apparently unable to fertilize themselves. At the present, however, the process of pollination appears almost as much in the dark as ever. It would appear that normal insect visits do not succeed in pollination, and that it is only when a visitor becomes trapped and struggles to escape that the floral mechanism is disarranged

[74] Demeter, K. *l. c.* 1922.

sufficiently to allow the reception of the pollen by the stigma. At any rate, fertilization is truly a phenomenon in the genus, for follicles are relatively rare.

In 1891 Robertson[75] compiled an extensive series of notes regarding the visits of insects to native flowers. His list of insect visitors to *Apocynum cannabinum* includes nineteen species of Hymenoptera, seventeen species of Diptera, two species of Lepidoptera, one species of Coleoptera, and two species of Hemiptera.

Fruit.—The fruit of the genus *Apocynum* is a pair of elongate, terete follicles. The distinctness of the two is marked, save in very early stages when they may be united at the tips. The short union at the tips, however, is responsible for a taxonomic character which has been used occasionally in the delimitation of taxonomic units. This character is a falcate appearance caused by unequal growth of the follicles when united at the tips, producing a gibbous condition.

The follicles are usually pendulous, but are erect in *A. pumilum* and its variety *rhomboideum.* This character, in the light of what has been previously written concerning the inflorescence of *A. pumilum,* might lead one to the thought that possibly the pendulous follicles of the other species represent a modification from a primitive erect condition.

The seeds are abundant, linear-terete, and abundantly comose at the micropylar end. The coma develops from the superficial cells of the outer integument which elongate into a sessile whorl. The seeds possess but a single integument, and the nucellus, composed of but a single layer of cells,[76] is evanescent. An endosperm, likewise, is absent from the mature seed. The length of the seed and coma is occasionally used as a taxonomic criterion in the revision which follows. At maturity the placenta withers away, leaving the follicle filled with free seeds which are easily dispersed by the wind upon dehiscence.

The embryo is straight, and typically dicotyledonous. Plate 4, fig. 5, represents the habit of the embryo of *Apocynum hypericifolium* magnified about twenty-five diameters. The embryo itself

[75] Robertson, C. Bot. Gaz. **16**: 70–71. 1891.
[76] Frye, T. C., & Blodgett, E. B. Bot. Gaz. **40**: 51–52. 1905.

is shuttle-shaped, the two fleshy cotyledons equalling about one-half the length of the body. The radicle is differentiated from the hypocotyl as an abruptly bevelled point. The plumule is not differentiated in the seed.

The vascular element of the embryo in the dormant seed is limited to procambium. It is not until the plumule is formed in the seedling that the normal vascular constitution is evident. The cells of the embryo are rich in protein and starch, although the latter is concentrated chiefly in the cotyledons. Latex inclusions are present only within cells similar in all other respects to the normal parenchyma. Such latex cells are infrequent.

Laticiferous System.—The Apocynaceae as a family are popularly notable chiefly because of the internal secretory system which occurs in all genera. The internal secretions, or latex, may be colorless, greenish, most frequently whitish, and rarely somewhat ochraceous. In the genus *Apocynum* the latex is chalky white, viscid, and coagulates spontaneously.

The latex of the genus *Apocynum*, as evidently throughout the family Apocynaceae, is contained in extensive cells which ramify nearly the entire plant. A few organs, notably the young absorptive roots and the anthers, are evidently without latex cells.

In the embryo, the initials of the latex cells first appear in the plane which coincides with the node of the cotyledons.[77] In the embryo of the fully mature seed, they are observed in the cotyledons which resemble the fundamental cells except in their contents. At such a stage, the hypocotyl does not usually appear to contain latex cells. Later, during the seedling stage, they extend to the hypocotyl as well as to the plumule.

In young absorptive roots, as has already been stated, latex tubes are lacking, or rare (pl. 4, fig. 1). In older roots, especially the gemmiferous roots, they occur freely, apparently being confined to the cortex in the majority of cases (pl. 4, fig. 2*h*). In the rhizome and stem they are apparently confined to the pericycle, where they are intimately associated with the pericyclic fibers (pl. 5, figs. 1–3 *j*). In some cases, particularly in young stems, however, isolated tubes are found in the outer layers of the pith (pl. 5, figs. 1–2 *m*). In the leaves, the laticiferous tubes are apparently restricted to the vascular bundles.

[77] *cf.* Chauveaud, G. Ann. Sci. Nat. Bot. VII. **14**: 108–109. 1891.

In the calyx, as in the leaves, the latex tubes are evidently associated with the vascular bundles. In the other floral parts, the corolla, the stamen filaments, and the gynoecium, including the nectaries, they ramify chiefly the non-vascular tissue (pl. 6, figs. 1*c*, 2*d*, and 3*c*; also pl. 3, fig. 4).

The latex of *Apocynum* contains suspended proteins, starch, and crystalloids, and yields over 2 per cent caoutchouc. The economic possibilities of the caoutchouc will be discussed in a subsequent section of the present study. The latex cells are evidently coenocytic.

INTRA-GENERIC RELATIONSHIPS

In the case of a genus so complex and difficult as *Apocynum*, it is manifestly impossible to submit a taxonomic revision immune to much justifiable criticism. In the opinion of Asa Gray, the total number of the species of *Apocynum* was two. His younger contemporary, Edward L. Greene, of an entirely different viewpoint in matters taxonomic, himself published over fifty species of the genus, and left herbarium names upon nearly a score of specimens in the United States National Herbarium and the Greene Herbarium at Notre Dame University.[78] Most of the Manuals and Floras which have dealt with the genus have fortunately striven to strike a mean between these two extremes, but frequently with a result which reflects the authors' uncertainty.

The specific concept in the present work is largely one of practical application. The watchwords have been qualitative constancy and geographical unity. Above all, the paramount necessity of a workable key has been recognized and supplied to the best of the author's ability. In taxonomic work the key is frequently, as indeed it should always be, the essence of the author's conception of his problem; and by his keys a taxonomist's work is most frequently liable to judgment.

In this revision, a key to all the species and varieties of the genus *Apocynum* is offered for the first time. Among the deficiencies of the monograph by Béguinot & Belosersky,[79] one of

[78] It is unfortunate that a considerable number of Greene's herbarium names were published as *nomina nuda* in the synonymy of Béguinot & Belosersky's monograph.
[79] Bég. & Bel. *l. c.* 1913.

the most conspicuous is a complete lack of keys or any other analytical differentia. This lack renders the work not only extremely ambiguous, but of little use to the botanical public.

From a glance at the Key to the Species which follows, it will be seen that the genus is roughly divisible into two groups, namely, species with drooping or spreading foliage and corolla at least twice the length of the calyx-lobes; and those with ascending foliage and corolla barely longer than the calyx-lobes. Within the first category there are two subdivisions: species with drooping leaves and corolla at least thrice the length of the calyx-lobes; and species with leaves spreading or rarely (*A. Suksdorfii* and *A. Jonesii*) ascending and corolla about twice the length of the calyx-lobes. The second category is divided into a group with leaves evidently petioled, narrowed at the base or the very lowest obtuse and subsessile; and a group with leaves mostly cordate or obtuse and sessile, especially below. Roughly, these four unnamed divisions correspond with Béguinot & Belosersky's sections "Androsaemifolii," "Medii," "Cannabini," and "Hypericifolii," with which those authors sought to subdivide the genus.

A study of the plants in the field, however, shows that there are no sharp lines of cleavage in the genus, and that the division of the genus into named sections is both unnecessary and artificial. It is found upon close study, even in the herbarium alone, that the species are so confluent as to make sectional lines extremely obscure. The cause of this specific intergradation, it is believed, is due to mass mutation through hybridism.

Evidently the flowers of all species of *Apocynum* are self-sterile, for otherwise they would yield theoretically 100 per cent fruit, since the anthers press so closely about the stigma that self-pollination is unavoidable. As a matter of fact, however, relatively few flowers are actually fertilized, say 10 per cent at most, which bespeaks the presence of another agency than the mere dropping of the pollen upon the stigma of the same flower. In the summer of 1928, bagging experiments were conducted in experimental plots of the Missouri Botanical Garden and in the field with evidence supporting the assumption of self-sterility. In the succeeding season efforts were made to self-pollinate *A. cannabinum*, with negative results.

It appears probable that through the glandulosity of the clavuncle, cross-pollination is effected by insects freeing the stigmatic surface of the flower in a violent attempt to reach the nectar secretions, thus allowing the subsequent cross-pollination by the same, or another visitor. The violence and frequency of insect visits to the flowers of *Apocynum* is attested by the numerous flies which are found trapped in them.

Lotsy,[80] the greatest exponent of the theory of the origin of species by hybridization and mass mutation, summarizes his observations as follows:

> "It was, to my way of thinking, the *coming into the world of sexual reproduction*, not response to stimuli, *which made evolution possible.* I may also express this so: that the difference is a double one, in as much as the theory of hybridization not only substitutes crossing for variability as the cause of evolution, but also considers those groups of individuals which systematists call species as mere remains of formerly very diverse swarms arisen from a cross, and not as the progeny of a single individual or two individuals, which, except in sex, were alike."

Without attempting to insert here a criticism of Lotsy's theories, especially with regard to the logical consequences of substituting *in toto* variations by hybridization for the infinitely slower accumulation of Darwinian variations, let it suffice to say that with regard to the genus *Apocynum*, the theories of Lotsy can be very favorably applied.

Reasons for assuming that the species of *Apocynum* are self-sterile and depend largely upon cross-pollination for sexual reproduction have already been given from a mechanical viewpoint. The obvious result of extensive hybridization, mass mutation, is found on every side by those who are willing to study the plant in the field. Clearly, in the case of *Apocynum*, the plants intergrade to such an extent that the taxonomist may well be led to agree with Lotsy that species arise by swarms and the subsequent falling out of the intermediates to form more or less isolated entities. Conservative botanists must allow great variability if they acknowledge a small number of species; others can recognize in the place of specific variability a large number of distinct species, as did Greene.

[80] Lotsy, J. P. Evolution considered in the light of hybridization, p. 59. Christchurch, N. Z. 1925.

Field observations have been a frequent source of information throughout the course of these studies; and in the case of the suspected hybridism of the genus they have apparently shed much light. Upon several occasions, notably in Indiana and Colorado, the hypothetical hybrids and the suspected parents have been found growing intermingled or in adjacent areas. In the summer of 1928, in company with Dr. J. A. Nieuwland of Notre Dame University, and upon another occasion with Dr. Edgar Anderson of the Missouri Botanical Garden, the writer visited a field at Notre Dame in which *A. androsaemifolium*, *A. cannabinum*, *A. hypericifolium*, and *A. medium* were abundant. Early in September, when the field was last visited, there was abundant fruiting material of the first three species; none, however, was apparent of *A. medium*. During the summers of 1927–29, field studies were made in the state of Colorado. At several points varieties of *A. medium* were discovered in areas adjoining one or both of the suspected parent species. Sterility of the hypothetical hybrid was always conspicuous.[81]

Near Bayfield, Colorado (see also p. 48), thousands of plants of *A. medium* var. *lividum* were discovered infesting a field of about fifty acres in extent. Throughout the entire field (pl. 8) not a single indication of fructification was found upon examination. Near Lyons, Colorado, the same variety was discovered in clones of several hundreds of plants each. No fructification was visible, although plants of *A. androsaemifolium* var. *incanum*, just across the road, and *A. hypericifolium* var. *salignum*, nearby, supposed to be the parents of the hybrid, provided abundant fruiting specimens.

At the base of Eagle Cliffs, in Moraine Park, Colorado, there exist intermingled clones of *A. androsaemifolium* var. *incanum* and *A. medium* var. *floribundum*. This particular location was visited in 1927 and again in 1929; and in neither year was fruiting material observed upon the *A. medium*, although follicles

[81] It is not meant to convey the impression that necessarily *all* of the supposedly hybrid species and varieties are absolutely sterile, however. The common eastern, or typical, variety of *A. medium* frequently produces follicles, and for that reason, as well as for its abundance and wide distribution, might be regarded as of earlier origin than the more restricted and apparently sterile western varieties of the same species.

were borne on *A. androsaemifolium.* This location is especially interesting because of the fact that in 1929 one small plant was found in flower which was strikingly intermediate between the two species. This plant is described as *A. androsaemifolium* var. *intermedium* in the taxonomic section which follows. The foliage of this plant is similar to that of *androsaemifolium,* but the flowers are strikingly intermediate, since, although the corolla-tube is cylindrical and only about twice the length of the calyx-lobes as in *A. medium* var. *floribundum,* the lobes are recurved as in *A. androsaemifolium* var. *incanum.* Statistically, the external measurements of the flowers of the three varieties growing at Eagle Cliffs are as follows; the figures are in millimeters:

	A. androsaemifolium var. *incanum*	*A. androsaemifolium* var. *intermedium*	*A. medium* var. *floribundum*
Length of corolla-tube, including the limb	6.5–7.5	4.5–5.5	3.5–4.0
Width of the corolla-tube at base	2.0–2.5	3.0–3.5	1.5–2.0
Width of the corolla-tube at orifice	5.0–6.5	3.0–3.5	1.75–2.0
Length of the calyx-lobes	1.0–1.25	2.0–3.0	2.0–2.5

Naturally, it is appreciated that in order to firmly substantiate the hypothesis of the speciation of *Apocynum* through hybridization, cytological studies should be made of each species, especially with regard to meiosis in the pollen-mother-cells. Unfortunately, however, the cytology of *Apocynum* presents serious difficulties. The formation of the tetrads occurs at an extremely early stage in the formation of the bud, young buds in which the stamens are mere filaments less than a millimeter in length invariably being found to contain tetrads. When one remembers that the sporangia occupy only about one-eighth of the mature stamen, the difficulty of the problem may be appreciated. The omnipresent latex also offers difficulties in killing and fixing. Since the primary object of this monograph is taxonomic and morphological, therefore it was decided to defer attempts at a cytological study.

However, certain cytological characteristics of hybrids are deducible through morphology. One of the most easily perceived of these is the irregular division of pollen-mother-cells producing polycary and polyspory through the independent organization of lagging univalent chromosomes. Of course hybridization may occur without such chromosomal incompatibilities or other phenomena may produce them, but the work of Rosenberg[82] on *Drosera* and other genera, and the work of Jeffrey[83] and others, have demonstrated clearly that hybrids can usually be detected through observation of the meiotic divisions of the pollen-mother-cells, and therefore by an examination of mature pollen, since hybrids very frequently betray the nature of their origin through the production of sterile and polysporous pollen.

Accordingly studies of the pollen of the species of *Apocynum* were made, both in the fresh state and in microscopic preparations. Since the pollen grains are held permanently in tetrads throughout the genus, polyspory can easily be detected in the forms which exhibit it. A certain amount of sterile pollen was evident in all of the species, and polysporous tetrads were found in others. The results may be summarized by stating that the four classic species of *Apocynum* (*A. pumilum*, *A. androsaemifolium*, *A. hypericifolium*, and *A. cannabinum*) have the smallest percentage of sterile pollen and that the intermediate species and varieties have a greater sterility. These findings are in accord with the taxonomic arrangement of the species in this monograph.

With the combination of taxonomic, morphological, and distributional observations, a phylogenetic chart has been prepared which illustrates, from the author's point of view, the speciation of the genus. Such visualizations are doubtless extremely liable to equivocation, but furnish a certain intellectual fascination which at times has led to deductions of value.

Text-fig. 11 is a phylogenetic chart illustrating the supposed speciation of the genus *Apocynum* through the hybridization of four potential ancestors. A few words of explanation and interpretation should perhaps be added. The broken lines present the

[82] Rosenberg, O. Cytologische und morphologische Studien an *Drosera longifolia* × *rotundifolia*. Kgl. Svenska Vet.-Akad. Handl. IV. 43: 3–64. 1909.

[83] Jeffrey, E. C., and Hicks, G. C. The reduction division in relation to mutation in plants and animals. Am. Nat. 59: 410–426. 1925.

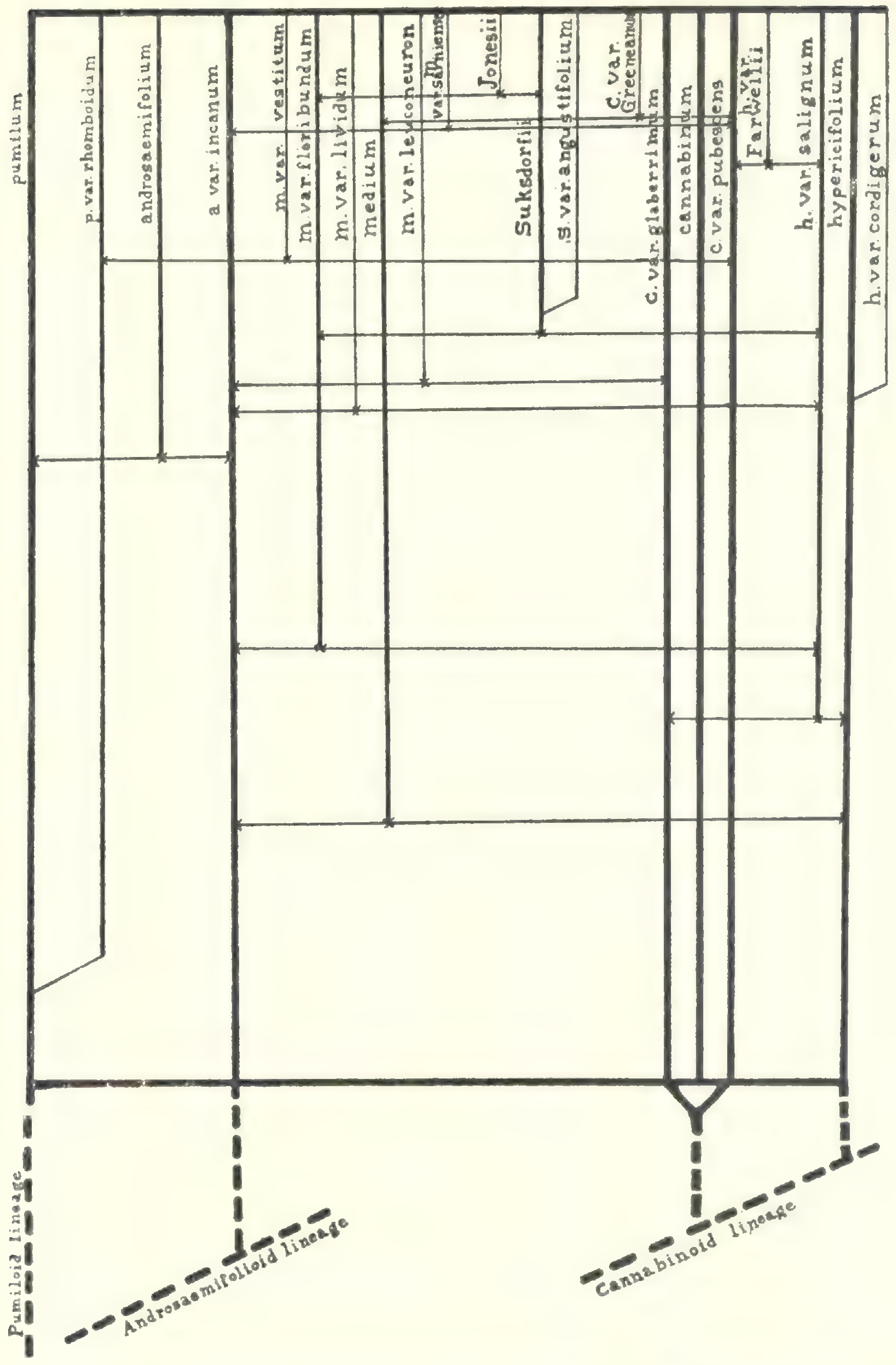

Fig. 11. Phylogenetic chart of the genus *Apocynum*. Explanation in text.

hypothetical rudiments of the genus; the solid lines, the supposed relationship of the known species and varieties. The length of the vertical solid lines indicates the supposed age of the species

and varieties; the thickness indicates their relative abundance. It will be noticed that of all the species and varieties diagrammed, only six continue straight to the ground-line. These species and varieties, *A. pumilum* (typical glabrous variety), *A. androsaemifolium* var. *incanum*, *A. cannabinum* and its two varieties, and *A. hypericifolium* (typical variety), are those whose origin cannot be hypothesized from any other existent forms, and which are apparently coeval. Of the other species and varieties, only three (*A. pumilum* var. *rhomboideum*, *A. Suksdorfii* var. *angustifolium*, and *A. hypericifolium* var. *cordigerum*), which are merely foliage varieties, are not suspected to be of hybrid origin. Hybridity is indicated by a connecting horizontal line, between the vertical lines of the two supposed parents, upon which is imposed a vertical line of length and thickness proportional to the relative abundance and suspected age of the species or variety.

Four species are considered older than the others, and are diagrammed as such. They fall naturally into three groups, which have been named for the sake of convenience. The first group, designated as the "pumiloid lineage" contains a single "primeval" species. This group is characterized by corollas thrice or more exceeding the calyx, drooping foliage, mostly alternate branching, and above all, by the erect, or nearly erect position of the follicles. The second group, the "androsaemifolioid lineage" likewise contains a single primeval species, and differs from the preceding group chiefly in the position of the follicles, which is decidedly pendulous. The third group, or "cannabinoid lineage" contains two primeval species which are characterized by corollas barely exceeding the calyx, erect or ascending foliage, opposite or subopposite branching, and pendulous follicles. Species and varieties having follicles which are strikingly intermediate between the erect and the pendulous, corollas about twice exceeding the calyx, and spreading (*i. e.* neither drooping nor ascending) foliage, are considered as indicating a nature intermediate between two of the three groups, and are diagrammed as hybrids upon the chart. Species and varieties characterized by the intermediate foliage and flowers moreover display in addition alternate branching by means of the abortion of an opposite branch-bud, an intermediate character of significance.

In constructing the chart, attention has been paid the geographical distribution of the species and varieties as well as their morphology. Instances of such use of geography are *A. pumilum* var. *rhomboideum* and *A. medium* (typical variety). *A. pumilum* var. *rhomboideum* is taken as an offshoot of *A. pumilum* (typical variety) instead of *vice versa*, because the latter has a range extending from the Pacific Coast to the Rocky Mountains, while the former inhabits only the region from the Pacific Coast to the Sierra Nevadas and Cascades. *A. medium* (typical variety) is taken as a product of *A. hypericifolium* and *A. androsaemifolium* var. *incanum* rather than of *A. cannabinum* and *A. androsaemifolium* var. *incanum*, because in Newfoundland and the New England states and adjacent Canada, where *A. cannabinum* is rare or lacking (see pl. 1), *A. medium* is coexistent with *A. androsaemifolium* var. *incanum* and *A. hypericifolium*, which are common species in the above-cited regions.

From an examination of the chart it will be perceived that specific lines in the genus *Apocynum* do not appear very "natural" (i. e., monophyletic). The outstanding example of this feature is the species *A. medium*, the varieties of which are believed to have arisen in different parts of North America from several different crosses between other species of the genus. These varieties, then, although supposedly of no direct relationship to each other, are grouped together as varieties of a single "species" because their taxonomic characters are so similar that, barring the consideration of independent origin by hybridization, they would appear quite like ordinary variations of a "natural" (i. e., monophyletic) species. The geographical distribution of many varieties of the genus appears to support the assumption of speciation through hybridism. For example, *A. medium* var. *sarniense* is known from only three stations: one in Ontario, one in Michigan, and one in British Columbia. *A. hypericifolium* var. *Farwellii* is known from one station each in New York, Michigan, Indiana, and Texas. *A. medium* var. *lividum* has been reported from several stations in Colorado and one station each in Washington and California. Such examples are of frequent occurrence, and together with the morphological and distributional considerations which have preceded, have lent encouragement to the drawing of preliminary conclusions from the mass of circumstantial evidence.

Even if the speciation of the genus through hybridization is disputed or disproved, the chart will serve to illustrate the apparent relationship and relative abundance of the species and varieties plotted. Breeding experiments are now under way to test the veracity of the chart, and it is hoped that within a few years more tangible knowledge than mere external similarities will be forthcoming.

An unfortunate anomaly is discovered in charting the typical variety of *A. androsaemifolium.* Linnaeus[84] described *A. androsaemifolium* as *utrinque glabra.* A. de Candolle[85] also regarded the typical condition of the species as glabrous, and described the variety with the under surface of the leaves puberulent as *A. androsaemifolium* var. *incanum.* As a matter of fact, the var. *incanum* is to all appearances the primitive condition of the species, and by far the more common, having a range covering nearly that of the genus; while the glabrous or "typical" variety is evidently a hybrid, possibly between *A. pumilum* (typical variety) and *A. androsaemifolium* var. *incanum,* with a range limited to the region west of the Rocky Mountains. Hybridity is suspected between the species suggested because of the campanulate corolla (characteristic of *A. androsaemifolium* var. *incanum*) and complete glabrity (characteristic of the typical variety of *A. pumilum*), but above all because of the erratic follicles (intermediate between the erect follicles of *A. pumilum* and the drooping follicles of *A. androsaemifolium* var. *incanum*). In spite of the probability that Linnaeus could have carelessly described the puberulent leaves of the eastern variety of the species as glabrous, since material from the Rocky Mountain region was scarcely well known to him, the fact remains that he so described them, and the example of de Candolle should be followed in the matter.

The phylogenetic method in Biology, and particularly in Botany, has numerous friends and foes. Hall and Clements,[86] continuing the theories of Bessey, have been outstanding in the advocation of phylogenetic speculation. Crow,[87] more recently, has criti-

[84] L. Sp. Pl. ed. 1. 213. 1753.

[85] A. DC. in DC. Prodr. 8: 439. 1844.

[86] Hall, H. M., and Clements, F. E. The phylogenetic method in taxonomy, etc. Carn. Inst. Washington, Publ. 326: 3–31. 1923.

[87] Crow, W. B. Phylogeny and the natural system. Jour. Genetics **17**: 85–155. 1927.

cized the phylogeneticists helpfully. According to him, phylogenetic Biology has apparently failed in its objective, and he remarks:

". . . current zoological and botanical literature reflects a loss of interest in phylogenetic research which contrasts strongly with that seen during the immediate post-Darwinian period, but which is obviously not due to the attainment of a fixed scheme of classification."

Continuing further, he observes:

"This state of affairs appears to be the outcome of at least two different trends of investigation. On the one hand, systematists themselves, finding the results of their detailed studies impossible to frame in a simple phylogenetic series, have frequently condensed their results in such a manner that obvious anatomical facts were overlooked, and fantastic interpretations placed on structure, in order to bring the facts into line with a preconceived simple scheme . . . On the other hand, the possibility of formulating a natural system has been challenged by the introduction of Mendelian ideas into heredity. . . It is sufficient here to point out that the criticism by the Mendelian theorists of the older phyletic theorists rests on the assumption that a knowledge of the method of evolution is necessary for the construction of a phylogenetic hypothesis. They agree that if Darwin's view, that gradual variations were chiefly responsible for evolution, was the last word on the subject, then the reconstruction of phylogenesis would be possible, but they think they have discovered some new facts regarding the nature of the variations responsible for evolution, and that these facts make phyletic reconstruction impossible."

The statements of Crow in criticism of the older phylogeneticist's methods, it will be noted, are in harmony with the viewpoint adopted in this study. After a prolonged consideration of the problem of species in representative fields of Biology, Crow concludes:

"(1) That the construction of phylogeny is not an arbitrary matter, but depends on certain facts concerning the natural system.

(2) Phylogeny consists of theories and hypotheses which do not differ in their nature from those of other branches of science. A satisfactory theory of the phylogeny of a group must however state the characters on which it is based.

(3) Convergence, which has hitherto been urged as one of the greatest objections to phylogeny, is a result of phylogeny and cannot be upheld as an objection to the phylogenetic method.

(4) Regression, although probably undetected in many cases, is likewise not a real obstacle to phylogenetic research.

(5) Mendelism and consequent possibilities, even if accepted, do not affect phylogenetic conclusions.

(6) The confusion of phylogeny with genealogy and the consequent misinterpretation of the aims of phylogeny has led to objections to the phylogenetic method which are without foundation . . . Thus in tracing the phylogeny

of species no account should be taken of the descent of individuals (genealogy) within the species any more than . . . one should take account of purely specific characters in tracing the descent of genera.

(7) The comparison of phylogeny with earlier forms of thought cannot in any way be regarded as an objection to it. Similar comparison can be applied to any branch of scientific thought."

The foregoing quotation from Dr. Crow is given because in a fair degree it coincides with the spirit which dominates this investigation of the Apocynoideae. However, some dissimilarity, especially in Crow's section (6) of his conclusions should be explained. Contrary to his views, it appears to the author that the importance of individual variation to the specific concept, and the specific variation in turn to the generic concept, especially in the light of evolution by means of hybridization, can scarcely be overestimated. That species arise from individuals, or at any rate from groups of individuals, and genera arise from species, appears to be unavoidable. Thus it appears somewhat illogical to divorce phylogeny from "genealogy," at least in theory, as indeed it is impossible practically to do so.

GEOGRAPHICAL DISTRIBUTION

The genus *Apocynum* is peculiar among the Apocynaceae in being entirely temperate in habitat. Confined to the continent of North America, by far the greatest number of species occurs only within the borders of the United States. All of the species and varieties recognized in this monograph occur in that country, with four species entering the Dominion of Canada, and three reported from Mexico. Three species are also native to Newfoundland. The only region of the United States in which the genus is apparently unknown is peninsular Florida. With its center of distribution in the United States, *Apocynum* finds its northern limit at about the 55th parallel, and its southern limit at about the 30th parallel.

As illustrated by the map in pl. 1 the species of the genus represent a case of progressive endemism. It will be seen that *A. androsaemifolium* and *A. cannabinum* have by far the greatest distribution of any of the species, extending throughout the entire range of the genus. *A. medium*, *A. hypericifolium*, and *A. pumilum* in the order named have the next largest distribution, while

the other species are shown with still more restricted ranges. Of the latter, *A. cannabinum* var. *Greeneanum* and *A. Jonesii* are the most local, each having been reported from a single locality.

The species of *Apocynum* have become as widely distributed ecologically as geographically. Their range of habitat is from saline and fresh water beaches to deep soil and subalpine situations. In general, however, they thrive best in a good field loam, growing with pasture plants with which they furnish lively competition in the struggle for existence. Species growing in such a situation develop robust plants, profusely branched and leaved, and attaining large proportions; while those growing in more extreme conditions are usually reduced in size, and may be sparingly branched and leaved. Plate 7 illustrates a typical clone of *A. cannabinum* var. *glaberrimum* in a cultivated field near Carondelet, Missouri.

Because of their frequency in cultivated fields, certain species have become common in ballast, and have tremendously increased their distribution in that manner. There are few roadsides or railroad right-of-ways in the United States beside which *Apocynum* is uncommon.

In a previous section of this study, reasons were advanced for supposing that hybridization has played a considerable part in the speciation of *Apocynum*. Support for such a view is afforded in a map of the species and varieties (pl. 1) where it is seen that those species and varieties assumed to be of hybrid origin exactly overlap in distribution that of the supposed parent stock.

ECONOMIC USES

The economic uses of *Apocynum* have been numerous and varied. Among primitive peoples it is frequently used as a source of thread and cord, the strong fibres of the plant earning the popular name of "Indian hemp" for *A. cannabinum*. Pickering[38] records that Janus Verazzanus, a Florentine mariner sent by Francis I to a "new country westward from Madeira," presumably North America, came upon natives wearing clothing composed of "certe erbe che stavano pendenti á rami degli alberi (*Tillandsia usneoides* L.)" interwoven with "canape silvestra

[38] Pickering, C. Chronological history of plants. p. 866. 1879.

(*Apocynum cannabinum* L.)." Fish-nets, bags, and even cloth have also been manufactured from the fibre of the genus by natives of North America. Fibre of *Trachomitum* and *Poacynum* have similarly been employed by the inhabitants of south-central Asia.[89] A decoction of *Trachomitum* is also used as a tannin by Central Asiatic tribes.

The active principle contained in the plant juices of *Apocynum* is apocynin, a drug which is soluble in both water and alcohol. An injection of apocynin has been shown to have much the same effect as that of digitalin, according to Planchon.[90] The powder of the root is frequently used in pharmacognosy as a substitute for ipecac.

An indirect economic use of *Apocynum* is found in the western United States, where fields are allowed to become crowded with the plants as a source of nectar for honey-bees.

Recently the economic potentialities of the latex and fibre of *Apocynum* have been demonstrated. As early as 1912 the abundant latex content of *A. androsaemifolium* was declared to be a neglected source of rubber by Fox,[91] who found the rubber content of the latex of that species to be 2.36 per cent. The rubber was found to coagulate spontaneously, and to be yielded in greater quantities from plants grown upon dry sandy soil than from plants growing in agriculturally more desirable land. The natural latex from dry-land *Apocynum* was found to contain 72.29 per cent water, 26.21 per cent solids, and 1.59 per cent ash.

In spite of the favorable demonstration of Fox, little further was done with respect to the economic possibilities of *Apocynum* until during the Great War of 1914–18, when industrial substitutes were in great demand. Accordingly a survey of western North American rubber-producing plants was begun in 1917 as

[89] [Singer, J.] Flora **54**: 222. 1871. "In ganz Sibirien, am kaspischen Meere, in Turkestan, Taschkund und in den Steppen Suedrussland wird der bast von *Apocynum venetum* und *A. sibiricum*, vielfach zu Geweben und Geflechten benutzt. Die auf der nationalen russischen Industrie-Ausstellung in St. Petersburg (1870) vorhandenen Gewebe, aus Suedsibirien eingeschickt, waren schoen glaenzend, fein und weich. Ferner waren auch, Fischernetze, Jaegertaschen und Schuhe aus demselben Stoff vorhanden. Die Faser ist ungemein theilbar, mehr noch als der Flachs, den sie an Weisse und Glanz weit uebertrifft."

[90] Planchon, C. Produits des Apocynacées. p. 213. 1880.

[91] Fox, C. P. Another Ohio grown rubber. Ohio Nat. **12**: 469–471. 1912.

a war-emergency project under the State Council of Defense of California by H. M. Hall and F. L. Long,[92] and published in 1921 by the Carnegie Institution of Washington.

The results of Hall and Long show that of the 225 species and varieties studied, the species of *Asclepias* and *Apocynum* indicated the greatest promise industrially. Instead of *A. androsaemifolium*, *A. cannabinum* is viewed by Hall and Long as the species most favorable as a substitute rubber plant, and a rubber yield of somewhat higher than 5 per cent was obtained from this species.

Concerning the fibre of *Apocynum*, especially *A. cannabinum*, there appears to be unanimity of approbation from commercial investigators. From both the experiments of Dodge[93] and of Hall and Long, the fibre of *A. cannabinum* was shown to be of great strength and fineness, and of great promise, especially in the manufacture of paper.

Agriculturally, *Apocynum* offers great advantage over flax in the production of fibre. Unlike *Linum usitatissimum* and other commercial fibres of the flaxes, *A. cannabinum* thrives at its best upon arid land unfit for any other agricultural use. The studies of Fox, as well as those of Hall and Dodge, demonstrate that both the fibrous and the latex content of all species of *Apocynum* reaches its optimum upon such land. With square miles of such waste land lying idle in western North America, the value of such a crop should be enormous.

TAXONOMY

APOCYNUM [TOURN.] L.[94]

Apocynum [Tourn.] L. Sp. Pl. ed. 1, 213. 1753; and ed. 2, 311. 1763; Gen. Pl. ed. 5, 101. 1754; Juss. Gen. 143. 1789; Sibth. Fl. Graeca **1**: 166. 1806 (as to *Trachomitum*); Pursh,

[92] Hall, H. M. & Long, F. L. Rubber-content of North American plants. Carn. Inst. Wash. Publ. 313: 65 pp. *3 pls.* 1921.

[93] Dodge, C. R. Descriptive catalogue of useful fiber plants of the world. U. S. Dept. Agr. Fiber Investig. Rept. **9**: 62–64. 1897.

[94] Apocynum L. char. emend. Calyx 5-partitus glaber vel pubescens eglandulosus. Corolla campanulata vel cylindrica, limbo 5-partito aestivatione sinistrorsum contorta, squamellis 5 separatim in tubo corollae insertis. Stamina 5 tubo corollae affixa inclusa cum corollae sequentis alternatis, filamentis brevibus cylindricis,

Fl. Am. Sept. ed. 2, **1**: 179. 1816; Nutt. Gen. **1**: 161. 1818; Roem. & Schult. Syst. **4**: 405. 1818; Michx. Fl. Bor.-Am. **1**: 121. 1803; Hook. Fl. Bor.-Am. **1**: 51. 1840; A. DC. in DC. Prodr. **8**: 439. 1844; Benth. & Hook. Gen. Pl. **2**: 716. 1876; Gray, Bot. Cal. **1**: 473. 1876; Coulter, Man. Bot. Rocky Mts. 237. 1885; Gray, Syn. Fl. N. Am. **2**^{1}: 82. 1886; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 179. 1895; Chapm. Fl. South. U. S. ed. 3, 341. 1897; Howell, Fl. N. W. Am. **1**: 439. 1901; Britt. Man. Pl. 738. 1901; Rydb. Fl. Colo. 269. 1906; Robinson & Fernald in Gray, New Man. Bot. ed. 7, 662. 1908; Bég. & Bel. Rev. Monogr. Gen. Apocynum, in R. Accad. Lincei, Atti, Mem. Sci. Fis. V. **9**: 1–144. 1913; Britt. & Brown, Ill. Fl. ed. 2, **3**: 21. 1913; Small, Fl. Southeast. U. S. ed. 2, 936. 1913.; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 505. 1915; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917; Standl. Contr. U. S. Nat. Herb. **22**^{5}: 395. 1921; Jepson, Man. Fl. Pl. Calif. 768. 1925; Tidestrom, Contr. U. S. Nat. Herb. **25**: 419. 1925.

Apocynastrum Heistr. *ex* Fabric. Enum. Meth. Pl. 256. 1759.

Apocinum Juss. Gen. Pl. 146. 1789.

Cynopaema Lunell, Am. Mid. Nat. **4**: 508. 1916.

Herbaceous lactescent perennials from somewhat thickened fibrous rhizomes. Stems erect or ascending, cylindrical, striate, glabrous or pubescent; branches ascending, alternate to opposite. Leaves opposite, petiolate or sessile, membranaceous, entire, penninerved, glabrous or pubescent, ovate to linear-lanceolate, bearing 2–6 small, attenuate, pectinate glands at the base of the petioles. Inflorescence a trichasial cyme, glabrous or pubescent, bracteate or ebracteate. Calyx regularly 5-lobed, glabrous or pubescent, the tube adnate to the receptacle, eglandular within. Corolla gamopetalous, campanulate to cylindrical, regularly 5-parted, glabrous, bearing within 5 distinct, sagittate appendages adnate to the base of the tube and opposite the lobes of the limb;

antheris sagittatis basi cum auriculis parallelis non verentibus instructis. Ovarium bilobum, lobis singularibus unilocularibus, ovulis in quoque loculo binis superpositis. Nectaria 5 integra supra discum propriam intra tubum calycis immersum. Folliculi teretes recti vel rarius falcati.—Herba perennis e rhizomate horizontali erecta ramosa, ramis ascendentibus plerusque alternis. Folia opposita petiolata vel sessilia et subamplexicaulia membranacea integra penninervia. Cymae pedunculatae terminales plus minusve compositae glabrae vel pubescentes.

limb erect, spreading or reflexed, sinistrorsely contorted in aestivation. Stamens 5, alternate with the appendages and attached to the base of the corolla-tube, convergent about the pistil; anthers of two small unilocular sporangia borne ventrally near the apex of an enlarged sagittate, peltately affixed connective; auricles of the anther connective parallel, with an open sinus, not convergent; filament short, cylindrical; pollen borne in persistent tetrads. Carpels 2, unilocular, sessile, united at the apices by an ovate-cylindrical clavuncle bearing the terminal stigma; ovules many, anatropous, borne upon an axile, binate placenta. Receptacle totally immersed in the calyx-tube, entire; nectaries 5, separate, ovate-cylindrical, situated upon the receptacle in a ring about the carpels. Follicles 2, divaricate, terete, containing many dry, apically comose, terete exalbuminous seeds; embryo straight.

Type species: *Apocynum cannabinum* L. Sp. Pl. ed. 1, 213. 1753.

KEY TO THE SPECIES

a. Leaves drooping or spreading (except *4–5*); corolla at least twice the length of the calyx-lobes.
  b. Leaves drooping; corolla at least three times the length of the calyx-lobes (except *1b*).
    c. Corolla campanulate, 5–10 mm. long, the orifice of the tube more than twice the width of the base; inflorescence rarely axillary as well as terminal; follicles normally pendulous; coma of the seeds 15–17 mm. long.
      d. Lower surface of leaves glabrous..............*1. A. androsaemifolium*
      dd. Lower surface of leaves tomentose..*1a. A. androsaemifolium* var. *incanum*
    cc. Corolla cylindrical, 4–6 mm. long, the orifice of the tube about equalling the width of the base; inflorescence usually axillary as well as terminal; follicles normally erect; coma of the seeds 12–15 mm. long.
      d. Corolla about twice the length of the calyx-lobes; follicles unknown, but supposedly pendulous..*1b. A. androsaemifolium* var. *intermedium*
      dd. Corolla at least three times the length of the calyx-lobes; follicles frequent, erect, or nearly so.
        e. Leaves glabrous..................................*2. A. pumilum*
        ee. Leaves variously pubescent......*2a. A. pumilum* var. *rhomboideum*
  bb. Leaves spreading or ascending; corolla about twice the length of the calyx-lobes.
    c. Leaves spreading; corolla relatively large, 4–5 mm. long.
      d. Corolla campanulate, the tube scarcely longer than the spread of the limb; primarily eastern varieties.
        e. Calyx and leaves variously tomentose; calyx-lobes lanceolate, acuminate, colored.

f. Corolla glabrous without; upper surface of leaves glabrous or glabrate.................................. *3. A. medium*

ff. Corolla hirtellous without; upper surface of leaves softly pubescent........................ *3a. A. medium* var. *sarniense*

ee. Calyx and leaves glabrous; calyx-lobes oblong to ovate, abruptly acute, colorless.................. *3b. A. medium* var. *leuconeuron*

dd. Corolla cylindrical, the tube conspicuously longer than the spread of the limb; western varieties.

e. Plant completely glabrous.......... *3c. A. medium* var. *floribundum*

f. Plant glabrous except the under surface of the leaves; calyx-lobes ciliate-erose.................. *3d. A. medium* var. *lividum*

ff. Entire plant pubescent; calyx lobes entire.. *3e. A. medium* var. *vestitum*

cc. Leaves ascending; corolla 2–3 mm. long.

d. Calyx-lobes ovate, about one-third the length of the corolla; corolla urceolate, about as long as broad.............. *4. A. Jonesii*

dd. Calyx-lobes lanceolate, about one-half the length of the corolla; corolla cylindrical, about twice as long as broad.

e. Leaves oblong, slightly spreading.................. *5. A. Suksdorfii*

ee. Leaves narrowly lanceolate, strictly ascending.. *5a. A. Suksdorfii* var. *angustifolium*

aa. Leaves ascending, corolla barely exceeding the calyx.

b. Leaves evidently petiolate, narrowed at the base, or the very lowest obtuse or sessile; bracts of the inflorescence scarious and aristate, not semifoliaceous or laminate; follicles relatively long and usually falcate, 12–20 cm. long, the coma of the seeds 20–30 mm. long.

c. Calyx-lobes decidedly shorter than the corolla; corolla 2–3 mm. long.

d. Plant pubescent, at least the lower surface of the leaves.

e. Plant glabrous, except the lower surface of the leaves. . *6. A. cannabinum*

ee. Inflorescence and both surface of the leaves pubescent....................................... *6a. A. cannabinum* var. *pubescens*

dd. Plant entirely glabrous............ *6b. A. cannabinum* var. *glaberrimum*

cc. Calyx-lobes equalling or slightly surpassing the corolla; corolla 3–4 mm. long...................... *6c. A. cannabinum* var. *Greeneanum*

bb. Leaves nearly or quite sessile, especially the lowermost, cordate or obtuse at the base; bracts of the inflorescence semifoliaceous or laminate; follicles relatively short and straight, 4–10 cm. long, the coma of the seeds 8–20 mm. long.

c. Corolla sphaerico-cylindrical, about as broad as long; coma of the seeds 8–12 mm. long; eastern and middle-western species.

d. Leaves oblong to lanceolate, the bases obtuse to cordate.

e. Plant glabrous.............................. *7. A. hypericifolium*

ee. Plant pubescent................ *7a. A. hypericifolium* var. *Farwellii*

dd. Leaves ovate to ovate-oblong, the bases deeply amplexicaul................................ *7b. A. hypericifolium* var. *cordigerum*

cc. Corolla tubulo-cylindrical, longer than broad; coma of the seeds 15–20 mm. long; western species........... *7c. A. hypericifolium* var. *salignum*

1. **Apocynum androsaemifolium** L. Sp. Pl. ed. 2, 311. 1762; Walt. Fl. Carol. 107. 1788; Lam. Encycl. 1: 213. 1783; Michx.

Fl. Bor. Am. **1**: 121. 1803; Pursh, Fl. Am. Sept. **1**: 179. 1814; Ell. Sketch Bot. S. C. & Ga. **1**: 314. 1821; Torr. Fl. N. & Mid. States, 275. 1824; Raf. Med. Bot. **1**: 49. 1828; Darl. Fl. Cestr. 167. 1837; G. Don, Hist. Dichlam. Pl. 81. 1838; Strong, Am. Fl. **4**: 72. 1850; Wood, Classb. Bot. ed. 29, 456. 1853; Darby, Bot. South. States, ed. 2, 434. 1860; Piper, Contr. U. S. Nat. Herb. **11**: 453. 1906.

Apocynum fol. androsaemi L. Sp. Pl. ed. 1, 213. 1753.

Apocynum androsaemifolium L. var. *glabrum* Macoun, Cat. Can. Pl. **2**: 317. 1884.

Apocynum ambigens Greene, Pl. Baker. **3**: 17. 1901; Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies 2^2: 193. 1911; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 505. 1915; Rydb. Fl. Rocky Mts. ed. 2, 669. 1917; Standl. Contr. U. S. Nat. Herb. **22**^{5}: 395. 1921; Tidestrom, Contr. U. S. Nat. Herb. **25**: 419. 1925; Garrett, Spring Fl. Wasatch Reg. 120. 1927.

Apocynum scopulorum Greene *ex* Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies **2**^{2}: 193. 1911; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 505. 1915; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917.

Apocynum androsaemifolium L. var. *microphyllum* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 87. 1913.

Apocynum ambigens Greene var. *bicolor* Bég. & Bel. *l. c.* 89. 1913, *non* MacGregor.

Apocynum androsaemifolium L. var. *typicum* Bég. & Bel. *l. c.* 80. 1913.

Apocynum occidentale Rydb. *ex* Bég. & Bel. *l. c.* 1913, *nomen, in synon.*

Apocynum androsaemifolium L. var. *orbiculatum* (Greene) Bég. & Bel. *l. c.* 81. 1913.

Cynopaema androsaemifolium (L.) Lunell, Am. Mid. Nat. **4**: 509. 1916.

Apocynum macranthum Rydb. Fl. Rocky Mts. ed. 2, 669. 1917.

Stems erect or ascending, 2–5 dm. tall, glabrous, freely and rather dichotomously branched, branches ascending, alternate to subalternate; leaves opposite, petiolate, drooping, ovate to oblong-lanceolate, membranaceous, glabrous, entire, mucronate, tapering at both base and apex; corolla campanulate, the base of the tube

less than one-half the breadth of the limb, 4–9 mm. long, the limb reflexed, 5–10 mm. broad at the orifice, calyx-lobes 1–3 mm. long, lanceolate to ovate-oblong, slightly flushed or colorless, glabrous; follicles 6–15 cm. long, pendulous, divergent, straight, not falcate, coma of seeds 1.5–2 cm. long, pale tawny-colored, seeds ovoid, 1 mm. long.

Distribution: woodlands, northwestern United States and adjacent Canada, eastward to the Dakotas, southward to California, Nevada, and Utah.

Specimens examined:

Canada:

British Columbia: bluff above Lardo, alt. 2000 ft., June 15, 1905, *Shaw 680* (US, NY, MBG).

United States:

South Dakota: Sylvan Lake, alt. 7000 ft., July 20, 1892, *Rydberg 871* (NY); Black Hills, near Ft. Meade, July 27, 1887, *Farwood 252* (US).

Nebraska; War Bonnet Canyon, alt. 5000 ft., June, 1890, *Williams* (US, MBG).

Texas: Davis Mts., Jeff Davis Co., upper Limpia Canyon, July 9–12, 1921, *Ferris & Duncan 2542* (NY, US, MBG).

Montana: Bozeman, Sept. 5, 1901, *W. W. Jones* (G); Deer Lodge, 1901, *Scheuber 1* (NY); Glacier Park, Aug. 18, 1919, *Standley 17846* (NY, US); Nevada Creek, hillsides, July 11, 1883, *Canby 226* (ANSP, US); Spanish Basin, Gallatin Co., June 23, 1897, *Rydberg & Bessey 4701* (ND); Belton, Oct. 3–4, 1919, *Standley 18821* (US); Grinnell Glacier, Glacier Nat. Park, July 31, 1919, *Standley 16845* (US); Bigfork, alt. 3000 ft., Aug. 6, 1908, *M. E. Jones 8881* (P); Darby, alt. 4000 ft., July 30, 1909, *M. E. Jones* (P); Yellowstone Park, Aug. 13, 1911, *Treakle 159* (P); Rexford, Sept. 16, 1908, *M. E. Jones 8880* (P).

Wyoming: open woods, Black Hills, July 25, 1910, *A. Nelson 9491* (G); Whalen Canyon, July 19, 1894, *E. Nelson 535* (US); Jaw-bone Gulch, July 9, 1896, *E. Nelson 2027* (P); Sheridan Co., above Big Horn, June 26, 1897, *Pammel & Stanton 71* (MBG); Jackson's Hole, Lincoln Co., alt. 6700 ft., dry roadside, Aug. 3, 1920, *Payson & Payson 2186* (MBG).

Colorado: Horsetooth Mt., July 20, 1897, *Crandall 1013*

(NY, US); Boulder Canyon, July, 1891, *Penard 500* (NY); Morrison, June 19, 1881, *B. H. Smith* (ANSP); hills, Larimer Co., June 15, 1895, *Patterson 6863* (P); Dome Rock in Platte Canyon, Aug. 8, 1878, *M. E. Jones 572* (P); hillside near Odessa Lake, Larimer Co., elev. 10000 ft., Aug. 15, 1927, *Woodson 1917* (MBG); dry slopes, Gregory Canyon, near Boulder, frequent, alt. 6000 ft., June 17, 1921, *H. C. Hanson 276* (MBG); Steamboat Springs, Routt Co., shady hillsides, July 20, 1903, *Goodding 1622* (MBG, NY, ANSP, US, F); Black Canyon, alt. 7000 ft., June 20, 1901, *Baker 202* (MBG, US, NY, W); clearings in rocky coniferous forests, above Cub Lake, Larimer Co., July 5, 1929, *Woodson & Anderson 29120* (MBG).

New Mexico: data lacking, *Fendler 690* (MBG, G); Wingfield's Ranch, Sacramento Mts., July 8, 1895, *Wooton* (US).

Idaho: Challis Creek, Custer Co., base of rock slide in canyon, alt. 6000 ft., July 19, 1916, *Macbride & Payson 3327* (G, P, MBG, US); Priest Lake, Aug., 1901, *Piper 3786* (G, US); crevice in recent lava flow, Martin, Blaine Co., alt. 6000 ft., July 5, 1916, *Macbride & Payson 3040* (G, NY, MBG); mountains, exact locality lacking, July, 1892, *Mulford* (G, MBG); Spencer, July 10, 1916, *Rust 247* (US); Middle Fork of Weiser River, Washington Co., Aug. 3, 1899, *M. E. Jones* (P); Divide between Mullan and Canyon Creek, Coeur d'Alene Mts., alt. 1020 m., Aug. 7, 1895, *Leiberg 1500* (MBG, G, US, NY, F); Priest River Exp. Sta., alt. 2700 ft., July, 1923, *Epling 6088* (MBG); Trinity, Elmore Co., Aug. 8, 1910, *Macbride 549* (MBG, US, W); Salmon, Lemhi Co., shaded roadside, alt. 4500 ft., July 3, 1920, *Payson & Payson 1886* (MBG, NY); hills southeast of Victor, Teton Co., alt. 6500 ft., July 28, 1920, *Payson & Payson 2170* (MBG, NY, G).

Utah: City Creek Canyon, July 23, 1884, July 26, 1883, *Leonard* (G); Provo, moist semi-shaded places, June 16, 1902, *Goodding 1127* (G, MBG, US, NY, ANSP, F, P); East Bountiful, Oct. 22, 1909, *Clemens* (NY); Parley's Canyon, Salt Lake Co., July 7, 1909, *Garrett 2450* (MBG); Mt. Nebo, July 15, 1905, *Rydberg 7761* (NY, US); Big Cottonwood Canyon, below Silver Lake, July 8, 1905, *Rydberg 6772* (NY, US); Provo, July 2, 1894, *M. E. Jones 5560* (P, US); Provo Slate Canyon, gravel, alt. 6000 ft., July, 1894, *M. E. Jones 5613* (P, MBG); Ogden, June 28–Aug. 1, 1890, *Pammel 5* (MBG).

Nevada: Lee Canyon, Charleston Mts., alt. 8000 ft., July 25, 1913, *Heller 10982* (MBG, US, G, NY); mountains west of Carson City, alt. 5000 ft., July 13, 1909, *Heller 9815* (US).

Washington: Three Tree Point, common in open places, May 30, 1910, *Bardell & Frye* (MBG); Wenatchee, Aug. 6, 1896, *Whited 142* (US); Loon Lake, July 20, 1897, *Wurston* (NY); Stehekin, Chelan Lake, July 6, 1911, *M. E. Jones* (P); Pullman, July, 1896, *Elmer 6863* (P); Pullman, on north hillside-meadows, July 4, 1896, *Elmer 138* (P); Pullman, July 25, 1900, *Piper 3508* (US, W).

Oregon: Trail Creek Canyon, alt. 1600 ft., June 2, 1897, *Sheldon 8208* (MBG, US); Emigrant Creek, Jackson Co., May 19, 1898, *Elmer 2216* (US); Corvallis, common along roads, May, 1922, *Epling 5574* (MBG).

California: data lacking, *Bridges 160* (NY); Strawberry, July, 1920, *Evans* (P).

There have been several misunderstandings concerning *A. androsaemifolium* which have had widespread circulation. One in particular concerns the pubescence or glabrity of the foliage. To practically all botanists who have had to do with the genus, the typical form of the species has been that of the collections from the eastern United States and Canada, the leaves of which have a densely tomentulose under surface. The western form with completely glabrous leaves has therefore frequently been relegated to some other designation, or ignored altogether. That the two forms are significant, however, their geographical distribution is proof. Linnaeus, in describing the species, spoke clearly of the foliage as "utrinque glabris," and A. deCandolle separated the glabrous typical form from a variety, var. *incanum*, a form with leaves "subtus pubescentibus." As a matter of fact, the possibility that Linnaeus's description was a careless description of the tomentulose form rather than a careful description of the glabrous form appears likely because of the abundance of the former. At any event, nomenclatorially, Linnaeus's *A. androsaemifolium* clearly describes the western glabrous variety, while deCandolle's var. *incanum* is as clearly the correct designation for the common dogbane of the eastern United States and Canada.

It is very rare to find the publication of *A. androsaemifolium*

L. correctly cited. Linnaeus first published the species (Sp. Pl. ed. 1, 213. 1753) as "*Apocynum fol. Androsaemi.*" Notwithstanding, the original publication of *A. androsaemifolium* L. (Sp. Pl. ed. 2, 311. 1762) is almost invariably given in our floras as well as monographic work[95] as "Sp. Pl. ed. 1, 213. 1753," perhaps in an effort to save priority and therefore usage for the common appellation. Such an effort, however, is unnecessary, since Linnaeus's earlier name was never taken up as such, and was therefore long ago invalidated by the so-called "Fifty-year Rule" of the International Code of Nomenclature.

1a. **Apocynum androsaemifolium** L. var. **incanum** A. DC. in DC. Prodr. **8**: 439. 1844; Wood, Classb. Bot. ed. 29, 456. 1853; Bég. & Bel. Atti R. Accad. Lincei V. **9**: 84. 1913. Plate 9.

Apocynum muscipulum Moench, Meth. 464. 1794.

"*Apocynum androsaemifolium* L." acc. to Hooker, Fl. Bor.-Am. **1**: 51. 1840; Torr. Fl. N. Y. **2**: 116. 1843; A. Gray, Bot. Cal. **1**: 473. 1876; Coulter, Man. Bot. Rocky Mts. 237. 1885; A. Gray, Syn. Fl. N. Am. **2**^{1}: 82. 1886; Coulter, Contr. U. S. Nat. Herb. **2**^{2}: 262. 1892; MacMillan, Metaspermae Minn. Valley, 421. 1892; Coville, Contr. U. S. Nat. Herb. **4**: 149. 1893; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 179. 1895; Chapm. Fl. South. U. S. ed. 3, 341. 1897; S. Coulter, Fl. Pl. Ind. 880. 1899; Rydb. Mem. N. Y. Bot. Gard. **1**: 311. 1900; Mohr, Contr. U. S. Nat. Herb. **6**: 674. 1901; Howell, Fl. N. W. Am. **1**: 439. 1901; Piper, Contr. U. S. Nat. Herb. **11**: 453. 1906; Rydb. Fl. Colo. 269. 1906; Robinson & Fernald in Gray, New Man. Bot. ed. 7, 662. 1908; Small, Fl. Southeast. U. S. ed. 2, 936. 1913; Britton & Brown, Ill. Fl. **3**: 21. 1913; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917; Bergman, Fl. Rocky Mts. 668. 1917; Bergman, Fl. N. D. 229. 1918; Tidestrom, Contr. U. S. Nat. Herb. **25**: 420. 1925; Garrett, Spring Fl. Wasatch Reg. 120. 1927.

Apocynum androsaemifolium L. f. *pauciflora* Peck, N. Y. State Mus. Rept. **47**: 158. 1894.

Apocynum incanum (A. DC.) G. S. Miller, Proc. Biol. Soc. Wash. **13**: 81. 1899, *in synon.*

Apocynum silvaticum Greene, Leafl. Bot. Obs. & Crit. **2**: 179. 1912.

[95] cf. Bég. & Bel. Monogr. Apocynum. Atti R. Accad. Lincei, V. **9**: 79. 1913.

Apocynum androsaemifolium L. var. *puberulum* Bég. & Bel. Atti R. Accad. Lincei V. **9**: 81. 1913.

Lower surface of leaves distinctly tomentulose or pubescent, in all other essential characters similar to the species.

Distribution: woodlands, occasionally in waste-lands, all over temperate North America, with a probable center of distribution in the northeastern United States and adjacent Canada.

Specimens examined:

Newfoundland: open woods near the confluence of the Exploits River and Badger Brook, Aug. 12, 1894, *Robinson & Schrenk 96* (G, MBG, US, F); ledges and talus, north bank of Exploits River below the falls, Grand Falls, July 22, 1911, *Fernald & Wiegand 6087* (G); Bishop Falls, July 28, 1911, *Fernald & Wiegand 6088* (G); "Sunnyside," Bay of Islands, fields, date lacking, *Waghorne* (MBG).

Canada:

Nova Scotia: dry open soil, Middleton, July 21, 1920, *Bissell, Pease & Long 22315* (G); dry exposed serpentine ledges in thin upland woods, Middlefield, June 26, 1913, *Fernald & Long 10240* (G); near "Sunny Brae," Pomquet, July 11, 1927, *Woodson 1713* (MBG); sandy thicket, Kentville, Aug. 22, 1902, *Fernald* (G); fields near Tarbet Vale, Cape Breton Island, July 23, 1914, *Nichols 289* (G); Ridge Road, above Springfield, Aug. 6, 1910, *Greene* (US, ND); edge of fields, near Windsor, July 21, 1857, *Howe* (NS).

Prince Edward Island: dry clearing, Alberton, July 11, 1912, *Fernald & St. John 7950* (G).

New Brunswick: Shediac, roadside, July 30, 1925, *Knowlton* (G); rich shaded soil, Shediac Cape, July 23, 1914, *Hubbard* (G); near Moncton, July 13, 1927, *Woodson 1714* (MBG); near McKinnon, July 13, 1927, *Woodson 1651* (MBG).

Quebec: gravelly beaches and flats, between Baldé and the Baie des Chaleurs, Bonaventure River, Aug. 5–6–8, 1904, *Collins, Fernald & Pease 5877* (G); Riviére Vaureal: le long du rivage de la riviére, July 28, 1925, *Victorin & Germain 21988* (G); near Ouatchouan Falls, Lake St. John, Aug. 29, 1904, *Wright 229* (G, US); mossy woods along the trail between Mont St. Louis and Lac Mont Louis, July 30, 1923, *Fernald, Dodge & Smith 25988*

(G); vicinity of Longueuil, Sept. 19, 1919, *Victorin 9652* (G); Lac Tremblant, Terrebonne Co., Aug. 4, 1922, *Churchill* (MBG, G, NY, US).

ONTARIO: Fort William, July 31, 1912, *Williamson 1692* (ANSP); Lake Cache, June 26, 1900, *Macoun* (US); cemetery near London, *Saunders, Anderson & Woodson* (MBG); vicinity of Ottawa, July 11, 1906, *Rydberg* (NY); St. Thomas, June 25, 1906, *Fisher* (D); near Heyden, 75 mi. north of Mackinac Straits, Aug. 2, 1906, *E. B. Williamson* (B); island in Lake Timagami, July, 1929, *Gilmour* (MBG).

MANITOBA: Lake Winnipeg Valley, 1857, *Bourgeau* (G, US); Brandon, July 20, 1896, *Macoun* (US); Athabasca, Aug. 12, 1901, *Preble & Preble 175* (US).

SASKATCHEWAN: exact locality not cited, 1857–58, *Bourgeau* (G).

BRITISH COLUMBIA: Goldstream, alt. 2200 ft., Aug. 3, 1905, *Shaw 1064* (G, MBG, US, NY, F); hillside, Carbonate, alt. 2750 ft., July 9, 1904, *Snyder 217* (G, US); Bald Mt., Cowichan Lake, June 17, 1907, *Rosendahl 1835* (NY, G, MBG); Telegraph Creek, Cassiar district, July 20, 1910, *Preble & Mixter 549* (US); Glacier, Illecillewaet Valley, Loop Trail, alt. 3500–4000 ft., July 20, 1906, *Brown 655* (G); lower Frazer River, 1859, *Lyall* (G); open ground, Victoria, date lacking, *J. R. Anderson* (W); orchards, Crawford Bay, date lacking, *Harrison* (W); river-bank, Skeena River, Comox District, Sept. 10, 1910, *J. R. Anderson 500* (W).

UNITED STATES:

MAINE: gravelly thicket, Sangerville, June 29, 1895, *Fernald 245* (G, MBG, US, NY); gravelly river-beaches, Fort Fairfield, July 16, 1902, *Williams, Collins & Fernald* (NE); Caribou, July 18, 1902, *Williams 1* (G); open woods, Green Mt., Mt. Desert, July 18, 1899, *Williams* (G); Augusta, July 10, 1886, *E. C. Smith* (MBG); Roque Bluff, dry sandy fields and roadsides, Aug. 11, 1907, *Cushman & Sanford 1621* (NE); Seal Harbor, Wildwood Farm, Sept. 1, 1892, *Rand* (NE); Standish, sandy clearings, Aug. 28, 1916, *Fernald & Long 14398* (NE, ANSP); Winthrop, 1864, *Sturtevant* (MBG); Topsham, bank of Androscoggin River, Aug. 26, 1912, *Furbish* (NE); Bridgton, July 9, 1912, *Martin* (NE); Swans Island, clearing on Stockbridge Hill, July, 1914, *Hill 1540* (NE).

New Hampshire: Glen, White Mts., Sept. 17, 1892, *Kennedy* (G); Jaffrey, July 23, 1896, *Day 70* (G, US); Randolph, along roadsides, July 27, 1897, *Williams* (G); Conway Center, Aug. 4, 1875, *Lane* (G); Gorham, R. R. tracks, Sept. 6, 1918, *Pease 17345* (NE); Gilmanton, summit of Shannon Mt., exposed granite, July 22, 1907, *Cushman & Sanford 1296* (NE); Merrimack, open roadside bordering swamp, Aug. 11, 1917, *Batchelder* (NE).

Vermont: Derbyline, dry knoll, July 19, 1914, *Churchill* (NE); Pownal, roadside, Aug. 2, 1898, *Churchill* (G); Arlington, July 3–4, 1903, *Eggleston 3291* (G, US); Manchester, roadside, July 14, 1898, *Day 19* (G, US); Mt. Mansfield, June 25, 1900, *Howell* (US); Peacham, July 12, 1885, *Blanchard* (MBG); Caledonia Co., July 2, 1884, *Blanchard* (MBG); Fairlee Center, Sept. 3, 1927, *E. Anderson 2700* (MBG); Vergennes, July 9, 1908, *Kennedy* (NE); East Wallingford, meadow, July 1, 1897, *Kent* (NE).

Massachusetts: West Tisbury, along road, Sept. 5, 1917, *Seymour 1431* (G); Conway, July 12, 1907, *Williams* (G); Worthington, open, slightly sandy roadside, Aug. 14, 1912, *Robinson 741* (G); West Roxbury, date lacking, *Faxon* (G); Tewksbury, June 27, 1853, *Boott* (G); Ipswich, borders of thickets, July 21, Sept. 10, 1874, *Morong* (MBG); Granville, Sept. 19, 1913, *Seymour 53* (MBG, G); Holbrook, June 18, 1899, *Greenman 616* (MBG); river-bank, Shelburne Falls, Franklin Co., July 1, 1921, *Churchill* (MBG, NY, US); Oak Island, July 9, 1898, *Greenman 3106* (MBG); Nonquit, 1888, *Sturtevant* (MBG); Alford, Aug., 1898, *Milligan* (MBG); South Framingham, July 3, 1890, *Sturtevant* (MBG); Pride's Crossing, dry loamy gravel, July 11, 1913, *Hubbard* (NE); Framingham, dry woods, July 13, 1911, *Eames* (NE); Lexington, moist pastures, Aug. 4, 1906, *Knowlton* (NE).

Rhode Island: North Smithfield, damp ditch on roadside, Aug. 4, 1910, *Hope 453* (NE); Foster, July 7, 1913, *Torrey 748* (NE); Cumberland, roadside, May 30, 1911, *Ware* (NE); Tiverton, roadside, July 7, 1909, *Sanford* (NE); Middletown, July 17, 1898, *Simmons* (NE).

Connecticut: Hartford, July 16, 1900, *Driggs* (NE); Trumbull, June 22, 1892, *E. H. Eames* (NE); Southington, woods and roadsides, common, June 14–Aug. 20, 1899, *Bissell* (NE); Water-

bury, July 27, 1912, *Blewitt 3674* (G); East Greenwich, 1861, *Fitch* (US).

New York: Sylvan Beach, Oneida Co., July 11, 1905, *House 1208* (G, NY); Lisbon, dry roadsides, July 9, 1914, *Phelps* (G); South Bay, Wellesley Is., June 28–30, 1902, *T. R. Robinson & W. R. Maxon 37* (G); Cape Vincent, July, 1905, *Keller* (ANSP); Fleischmann's, Delaware Co., July 13, 1892, *Schrenk* (MBG); Granville Tp., Washington Co., Aug. 19, 1921, *Drushel 2434* (MBG); Little Moose Lake, Herkimer Co., July 5, 1906, *Van Pelt* (ANSP); Goat Island, Niagara River, July 19, 1870, *Boice* (ANSP); near Oneida, July 8, 1909, *Mrs. Maxon 4541* (ANSP); Ithaca, Cascadilla Creek, June 18, 1877, *Trelease* (MBG); New London, June 28, 1921, *House 8294* (NY); Ithaca, dry woods, June 28, 1916, *Munz 599* (P); Norwich, Chenango Co., June 24, 1887, *Fitch* (P).

New Jersey: Windham road, July, 1889, *R. C. Perry* (MBG); Netcong, Morris Co., Aug. 19, 1906, *Mackenzie 2290* (MBG, NY, US); Lakewood, Ocean Co., sandy woods, May 30, 1908, *Mackenzie 3102* (MBG, NY).

Pennsylvania: Bushkill, Pike Co., June 30, 1917, *Bartram* (G, ANSP); Binton, Columbia Co., July 8, 1921, *Meredith* (ANSP); Tannersville, July 4, 1901, *S. Brown* (ANSP); Meadville, June 30, 1893, *C. D. Curtis* (P); Columbia, June, 1889, *Eby* (MBG); moist places along the Susquehanna trail near Selinsgrove, Aug. 4, 1926, *Heller 14232* (MBG, US); bluff along the Susquehanna River above Nescopec, about or near trees, Aug. 3, 1926, *Heller 14204* (MBG); Northampton Co., 1880, *Rau 66* (MBG); Mt. Alto, 1909, *Illick* (MBG).

Delaware: Centerville, July ,1865, *Commons* (MBG, ANSP).

Maryland: Oakland, Garrett Co., July 7, 1881, *Donnell-Smith* (US, G); Oakland, July 12, 1899, *Greene* (US).

Virginia: Stony Man Mt. and vicinity, near Luray, alt. 3700 ft., Aug. 15, 1901, *Steele & Steele 238* (MBG, US, NY); Shannon Gap, Walker Mt., Smyth Co., June 21, 1892, *Britton, Britton & Vail* (NY); Peaks of Otter, Bedford Co., July 26–Sept. 1, 1871, *Curtiss* (G, US).

West Virginia: Bucklin, Upshur Co., June 10, 1895, *Pollock* (MBG, US).

North Carolina: open woods and fields, Biltmore, Buncombe Co., July 16, 1897, *Biltmore 80b* (MBG, P, G, US, NY); "mountains of North Carolina," exact locality and date lacking, *Ashe* (US).

Ohio: Put-in-Bay, July 10, 1920, *Mosely* (G); Rocky River, near Cleveland, July 13, 1896, *Greenman 1437* (G, MBG); Columbus, date lacking, Sullivant (G); Painesville, June, 1885, *Beardslee* (US).

Michigan: Stevensville, sandy ground near railroad, July 3, 1911, *Lansing 3213* (G, F); Burt Lake, roadside, July 27, 1917, *Ehlers 559* (G, US); Hamlin Lake, Ludington, July 25, 1910, *Chaney 92* (G); Turin, Marquette Co., July 8, 1901, *Barlow* (G); Iron Mt., June, 1885, *Rydberg 130* (NY); Schoolcraft, railroad banks, June 6, 1903, *Burgess 62* (F); roadside banks 15 miles west of Ann Arbor, Aug. 22, 1926, *Heller 14258* (MBG); Lansing, July 7, 1867, *Sleeper* (MBG); Gt. Manitou Is., Lake Superior, July 26, 1886, *Wislizenus 579* (MBG); Houghton Co., Aug., 1892, *Eby* (MBG); Ypsilanti, June 23, 1892, *Farwell* (US).

Indiana: Gibson, sandy ridges, Aug. 10, 1910, *Lansing 2820* (G, US, F); Millers, dry copse, July 7, 1908, *Lansing 2764* (G, F); Whiting, Aug. 29, 1893, *Britton* (NY); Notre Dame, Aug. 5, 1909, *Nieuwland* (MBG); Bluffton, along fence ½ mile east of town, June 24, 1906, *Deam 1125* (MBG, D); Michigan City, July 3, 1903, *Mell 23* (MBG, US); Gary, July 19, 1907, *Greenman 1864* (MBG); in wooded lot across railway from Notre Dame University, June 29, 1928, *Nieuwland, Slavin & Woodson 2* (MBG); bank of the St. Mary's River about 2 mi. southeast of Pleasant Mills, Adams Co., June 25, 1925, *Deam 41342* (D); Fulton Co., along the Lake Erie Railroad, between Rochester and Tiosa, not frequent, June 25, 1911, *Deam 8923* (D); high bank of the Salamanie River, 1 mi. east of Montpelier, Blackford Co., June 22, 1925, *Deam 41320* (D); dry wooded bank of Cedar Creek, about 3 mi. above Cedarville, Allen Co., June 14, 1914, *Deam 14283* (D); black oak sand hill along roadside, 5 mi. west of Gifford, Jasper Co., July 14, 1920, *Deam 31710* (D); Marshall Co., on the border of Lake Maxinkuckee, just south of Culver, July 2, 1911, *Deam 8997* (D); on wooded dune about 2 mi. west of Michigan City, not frequent, June 18, 1911, *Deam 8848* (D).

WISCONSIN: Brown Co., 1886, *Scheutte* (G); River Falls, Aug., 1903, *Powell* (G); Waupaca, 1907, *Garesche* (MBG); woods near Mirror Lake, Sauk Co., Aug. 23, 1903, *Eggert* (MBG); low open ground, near lake, Odanah, Ashland Co., Sept. 11, 1925, *E. J. Palmer 28651* (MBG); Burg road, near Garrett Bay Inn, Ellison Bay, Door Co., July 16, 1918, *M. T. Greenman 52* (MBG); St. Croix Falls, Polk Co., July 10, 1899, *C. F. Baker* (P); Arena, date lacking, *Carr* (P).

ILLINOIS: Urbana, date lacking, *Gleason* (G); Flossmoor, Aug. 1, 1909, *Greenman 2815* (G, MBG, NY); Decatur, 2 miles from Moffit's Bridge, on the Moffit road, June 29, 1895, *Gleason 336* (G); bank of Desplaines river, Maywood, June 24, 1898, *A. Chase* (MBG, US); steep clay bank near Wady Petra, June 30, 1900, *V. H. Chase 647* (MBG, US); Illinois State Park, Starved Rock, LaSalle Co., June–Sept. 1921, *Thone 61* (MBG, F); Cook Co., July, 1870, *Babcock* (MBG, US); Lake Forest, May–Sept., 1897, *Jensen* (MBG).

MINNESOTA: Clithrall, July, 1897, *Campbell* (G); Bemidji, Beltrami Co., June, 1902, *Brand 591* (F); Taylor's Falls, July 28, 1900, *Banks 21* (ND, US); Norway Beach, Cass Lake, sandy soil, border of woods, July 9, 1925, *Pammel 864* (MBG); Itaska Lake, June 29, 1892, *Sandberg* (US); Soudan, St. Louis Co., July, 1896, *Eby* (MBG); Center City, July, 1892, *Taylor* (W), borders of thickets, Fish Lake, Mahnomen Co., July 21, 1908, *Chandonnet* (D).

IOWA: Iowa City, 1889, *Hitchcock* (MBG); Ames, Aug. 26, 1897, *Johnson* (MBG); border of woods, Fayette Co., July, 1894, *Fink* (US).

MISSOURI: Ironton, June 23, 1897, *Savage & Steele 310* (F); Joplin, rocky ground, June 7, 1909, *E. J. Palmer, 2129* (G, MBG, US); Dumas, rocky banks, July 6, 1909, *Bush 5871* (MBG, G, US); Eagle Rock, uncommon, near spring, June 26, 1897, *Bush 15* (G, MBG, US); near Allenton, high sandy hill, June 30, 1912, *Letterman* (MBG); Howell Co., Aug. 12, 1892, *Bush* (MBG); rocky hills, St. Louis Co., May 15, 1896, *Eggert* (MBG); "rare and local, a clump at Castle Rock," Turkey Creek, near Joplin, June 7, 1909, *E. J. Palmer 2172* (MBG, US); Jerome, June 16, 1914, *Kellogg* (MBG); open rocky woods, north slope along

Turkey Creek, near Joplin, Jasper County, June 22, 1928, *E. J. Palmer 34643* (MBG); thickets along rocky creek near Mansfield, Wright Co., June 25, 1928, *E. J. Palmer 34692* (MBG).

Arkansas: rocky open ground, near top of Magazine Mt., Logan Co., June 11, 1923, *E. J. Palmer 23248* (MBG).

North Dakota: Minot, July 2, 1907, *Lunell* (NY); Devil's Lake, Ramsey Co., July 1, 1905, *Lunell* (NY, US, ND, D); Turtle Mts., Bottineau Co., July 21, 1905, *Lunell* (ND, D); roadsides, open plain, Turtle Mts., July 29, 1910, *Lunell* (US); Des Lacs, Ward Co., August 22, 1908, *Lunell* (D).

South Dakota: damp woods, Warren's Woods, June 14, 1902, *Johnson* (MBG); Rockerville, Black Hills, June 15–30, 1909, *White* (MBG); Simpson Park, June, 1895, *Griffiths* (MBG); Deadwood, hillsides, July 13, 1913, *Rydberg 95* (MBG, NY); Deadwood, hillsides, July 13, 1913, *Carr 95* (G); Rapid City, alt. 3700 ft., June 25, 1892, *Rydberg 871* (G); Redfern, elev. 5700 ft., July 12, 1910, *Murdock 4214* (G).

Nebraska: Belmont, July 24, 1889, *Webber* (MBG).

Montana: Red Lodge, July 24, 1893, *Rose 2* (G, US); Mt. Bridger, Gallatin Valley, alt. 5,000 ft., Aug. 10, 1905, *M. E. Jones* (P); McDougall Peak, Schultze's Cabin, alt. 3500 ft., July 29, 1908, *M. E. Jones* (P); Butte, June, 1892, *Keller* (ANSP); Bozeman, dry mountain slopes, frequent, July 28, 1901, *Blankinship* (MBG, US); Bigfork, July–Aug. 1907, *Elrod* (MBG).

Wyoming: Nez Perces Creek, July 29, 1899, *Nelson & Nelson 6206* (G); Leigh's Lake, open woods, July 24, 1901, *Merrill & Wilcox 1084* (G, US); Chug Creek, Albany Co., rocky slopes among the hills, June 29, 1900, *A. Nelson 7329* (US, MBG); Black Hills, open woods, July 25, 1910, *A. Nelson 9491* (MBG, US, NY).

Colorado: Manitou, Oct. 9, 1905, *Glatfelter* (MBG); base of Palisade Mt., Larimer Co., elev. 8000 ft., Aug. 12, 1927, *Woodson 1822* (MBG); Roger's, Aug. 14, 1901, *Baker 799* (MBG, US, NY, G, ND, F, ANSP, P); Boulder, 1908, *Pace 472* (MBG); Artist's Glen, alt. 2800 m., July 22, 1900, *Clements & Clements 107* (G, US, MBG, NY, F); Tabergauche Basin, exposed sandy hillside, alt. 8500 ft., Aug. 18, 1913, *Payson 178* (MBG, G, US); Steamboat Springs, shady hillsides, July 20, 1903, *Goodding 1622* (G,

US); Engelmann Canyon, 2700 m., July 27, 1901, *Clements & Clements 398* (MBG, G, US); Pagosa Springs, July 17, 1899, *Baker 527* (MBG, US, ND, P, G); Mancos, July 9, 1898, *Baker, Earle & Tracy 840* (P, G); Canyon City, 1872, *Brandegee* (MBG); San Juan Mt., near Pagosa Springs, Aug. 14, 1917, *Payson 1172* (MBG); Green Lake, alt. 10000 ft., July 5, 1886, *Letterman* (MBG); Upper Clear Creek Valley, Aug. 6, 1874, *Engelmann* (MBG); Piedra, July, 1899, *Baker 527* (F); Twin Lakes, 1873, *Rothrock & Wolf 45* (ANSP); Wahatoya Creek, July 7, 1900, *Rydberg & Vreeland 5756* (NY); rocky shores of Arkansas River, near Granite, Chaffee Co., July 3, 1929, *Woodson & Anderson 29089* (MBG); rocky hillsides below Independence Pass, Lake Co., alt. 9500 ft., July 3, 1929, *Woodson & Anderson 29123* (MBG); stream banks, near mouth of North St. Vrain Canyon, west of Lyons, Boulder Co., July 9, 1929, *Woodson & Anderson 29002* (MBG).

New Mexico: Pecos River National Forest, Winsar's Ranch, alt. 8400 ft., July 1, 1908, *Standley 4102* (MBG, US); Pews River, July 23, 1898, *Coghill 96* (MBG); Colfax Co., alt. 7500 ft., June, 1896, *St. John 42* (G); Lookout Mines, Sierra Co., June 14, 1904, *Metcalfe 981* (G, US, P); locality lacking, 1847, *Fendler* (G, MBG); Cloudscroft, June 30, 1899, *Wooton* (P, US); vicinity of Chama, Rio Arriba Co., July 10, 1911, *Standley 6791* (US); Eagle Creek, Lincoln Co., July 14, 1895, *Wooton* (NY); dry open hillside, northwest of Chama, Rio Arriba Co., June 26, 1929, *Woodson & Anderson 29112* (MBG).

Idaho: Upper Priest River, July 8, 1925, *Epling 7182* (F); Oxford, July 21, 1883, *Coville* (US); "mountains," exact locality lacking, July, 1892, *Mulford* (MBG).

Utah: Red Butte Canyon, vicinity of Salt Lake City, July 11, 1908, *Clemens* (MBG); Alta, Wasatch Mts., alt. 8000 ft., Aug. 14, 1879, *M. E. Jones 1272* (P); Salt Lake City, July 19, 1904, *Scheuber* (US).

Arizona: Miller's Canyon, Huachuca Mts., dry burnt slopes, June 8, 1909, *Goodding 120* (G, US); Pine Canyon, Chiricahua Mts., alt. 7200 ft., June 26, 1907, *Blumer 1543* (G, MBG, US); Baker's Butte, July 28, 1897, *Mearns* (NY); Flagstaff, July 8, 1898, *MacDougal 254* (ANSP); near Soldier's Camp, Santa

Catalina Mts., July 30, 1916, *Harris 16394* (MBG); Santa Catalina Mts., Pima Co., June, 1891, *Rhoads* (ANSP).

WASHINGTON: Clark Springs, Spokane, July 7, 1902, *Kreager 89* (G); Mt. Constitution, San Juan Islands, June 25–Aug. 1, 1917, *Zeller & Zeller 1187* (G, MBG); Lake Chelan, July 1, 1915, *Kammerer* (NY); Moulisano, Aug. 14, 1917, *Grant* (NY); Falcon Valley, July, 1908, *Suksdorf* (NY).

OREGON: Portland, 1868, *Kellogg & Harford 842* (NY); Columbia River Valley, Aug., 1884, *Ball* (MBG).

CALIFORNIA: Sierra Co., 1874, *Lemmon* (G); Dollar Lake Canyon, San Bernardino Co., alt. 9000-9500 ft., July 12, 1908, *Abrams & MacGregor 774* (G); dry gravel bank, east fork of Lost Creek, San Bernardino Co., alt. 8500 ft., July 15, 1924, *Munz & Johnston 8596* (G, P); near Dry Lake, along stream, alt. 8000 ft., July 16, year lacking, *Crawford* (P); Bluff Lake, San Bernardino Co., alt. 7500 ft., June 15, 1905, *Grinnell 78* (P); North Bay, Bear Valley, dry shore, Aug. 1, 1922, *Pierce* (P); Bear Valley, San Bernardino Mts., alt. 6600 ft., July 19, 1900, *M. E. Jones* (P).

MEXICO: San Pedro Martir Mts., exact locality lacking, July 15, 1905, *Goldman 1221* (US); Colonia Garcia, Chihuahua, in Sierra Madres, June 12, 1899, *Townsend & Barber 33* (US, MBG, P).

1b. Apocynum androsaemifolium L. var. **intermedium** Woodson, n. var.[96]

Corolla cylindrical, about twice the length of the calyx-lobes; in all other essential characters similar to the species.

Distribution: known only from the type locality in north-central Colorado (for a detailed account of this variety see pp. 72–73).

Specimens examined:

COLORADO: evidently *A. androsaemifolium* var. *incanum* × *A. medium* var. *floribundum.* Growing with those species below Eagle Cliffs, Moraine Park, Larimer Co., July 25, 1929, *Woodson & Barnhart 29032* (MBG).

[96] **Apocynum androsaemifolium** L. var. **intermedium**, var. nov., herbaceum perenne, varietatem genuinam simulans differt foliis subtus pilosis corollae tubo cylindrico calycis lobis dimidio majoribus.

2. **Apocynum pumilum** (A. Gray) Greene, Man. Bot. San Francisco Bay, 240. 1894; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 91. 1913; Piper & Beattie, Fl. S. E. Wash. 194. 1914; Rydb. Fl. Rocky Mts. ed. 2, 669. 1917; Standl. Contr. U. S. Nat. Herb. **22**[5]: 395. 1921.

Apocynum androsaemifolium L. var. *pumilum* A. Gray, Syn. Fl. N. Am. **2**[1]: 82. 1886; Howell, Fl. N. W. Am. **1**: 439. 1901; Piper, Contr. U. S. Nat. Herb. **11**: 453. 1906; Frye & Rigg, Northwest. Fl. 308. 1912; Smiley, Bor. Fl. Sierra Nev. Cal. 300. 1921; Jepson, Man. Fl. Pl. Cal. 769. 1925.

Apocynum calophyllum Greene, Leafl. Bot. Obs. & Crit. **1**: 57. 1904; Tidestrom, Contr. U. S. Nat. Herb. **25**: 420. 1925.

Apocynum cardiophyllum Greene, *l. c.* 79. 1904.

Apocynum bicolor McGregor, Bull. Torr. Bot. Club **37**: 261. 1910.

Apocynum ovalifolium Greene, *l. c.* **2**: 182. 1912.

Apocynum paniculatum Greene, *l. c.* 183. 1912.

Apocynum stenolobum Greene, *l. c.* 1912.

Apocynum eximium Greene, *l. c.* 1912.

Apocynum plumbeum Greene, *l. c.* 185. 1912: Tidestrom, Contr. U. S. Nat. Herb. **25**: 420. 1925.

Apocynum xylosteaceum Greene, *l. c.* 1912.

Apocynum rotundifolium Greene, *l. c.* 186. 1912.

Apocynum Austinae Greene, *l. c.* 188. 1912.

Apocynum cercidium Greene, *l. c.* 1912.

Apocynum luridum Greene, *l. c.* 189. 1912.

Apocynum pumilum (A. Gray) Greene var. *typicum* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 91. 1913.

Apocynum hypericifolium Ait. var. *intermedium* Bég. & Bel. *l. c.* 92. 1913, *nomen in synon.*

Apocynum pumilum (A. Gray) Greene var. *cercidium* (Greene) Bég. & Bel. *l. c.* 94. 1913.

Apocynum pumilum (A. Gray) Greene var. *calophyllum* (Greene) Bég. & Bel. *l. c.* 1913.

Apocynum pumilum (A. Gray) Greene var. *ovalifolium* (Greene) Bég. & Bel. *l. c.* 1913.

Apocynum pumilum (A. Gray) Greene var. *xylost[e]aceum* (Greene) Bég. & Bel. *l. c.* 95. 1913, *err. typ.*

Apocynum pumilum (A. Gray) Greene var. *plumbeum* (Greene) Bég. & Bel. *l. c.* 95. 1913.

Apocynum pumilum (A. Gray) Greene var. *stenolobum* (Greene) Bég. & Bel. *l. c.* 96. 1913.

Apocynum androsaemifolium L. var. *nevadense* Jepson, Man. Fl. Pl. Cal. 769. 1925.

Stems erect, ascending, or diffuse, 1–4 dm. tall, freely and rather dichotomously branched, branches ascending or spreading, alternate to subalternate, glabrous; leaves opposite, ovate to oblong-lanceolate, petiolate to subsessile, drooping, acute to obtuse at base and apex, or cordate-obovate, membranaceous, entire, mucronate, or without mucro, glabrous; corolla cylindrical, 4–6 mm. long, 4–5 mm. broad at the orifice, the base of the tube more than one-half the breadth of the limb, the limb erect or slightly spreading, rarely reflexed except in withering; calyx-lobes lanceolate to oblong-ovate, 1–1.5 mm. long, colorless to deeply tinted, glabrous; follicles 5–12 cm. long, erect, divergent, straight, not falcate, coma of seeds 1–2 cm. long, clear white, or occasionally tawny-colored, seed ovoid-cylindrical, 1.5–2 mm. long.

Distribution: western temperate North America; frequent in the Pacific coast area, less frequent inland to the Rocky Mountains.

Specimens examined:

Montana: Big Fork, July 21, 1908, *Butler 2131* (NY); Blackfoot Valley, north bank of irrigating ditch, July 23, 1921, *Kirkwood 1253* (MBG); slopes of Altyn Peak, Glacier Nat. Park, alt. 1480–1720 m., July 13, 1919, *Standley 15553* (G, US); Deep Creek Co., July, 1883, *Scribner 152* (G); Spring Gulch, Hellgate Canyon, July 13, 1921, *Kirkwood 1252* (MBG).

Wyoming: Encampment, Carbon Co., river bottoms, July 10, 1901, *Tweedy 4640* (NY, US); Alpine, Lincoln Co., on the Snake River near the Idaho boundary, open slopes, July 7, 1923, *Payson & Armstrong 3382* (P, MBG); Nez Perces Creek, on dry slopes and flats, July 29, 1899, *Nelson & Nelson 6206* (MBG); Dale Creek, Aug. 24, 1908, *Clemens* (MBG).

Idaho: Martin, Blaine Co., July 5, 1916, crevice in recent lava flow, alt. 6000 ft., *Macbride & Payson 3040* (MBG); valley of

Big Potlach River, Nez Perces Co., July 9, 1892, *Sandberg, MacDougal & Heller 372* (G); Salmon, Lemhi Co., alt. 4500 ft., July 3, 1920, *Payson & Payson 1886* (MBG, G); Boise, alt. 2880 ft., mountain sides everywhere, Sept. 14, 1911, *Clark 330* (G); Tamarack, Washington Co., Aug. 12, 1911, *Clark 243* (MBG); Boise, Clear Creek, open hillsides, alt. 5000 ft., July 4, 1911, *Clark 101* (MBG, W); Mann's Creek, Washington Co., alt. 2200 ft., July 8, 1899, *M. E. Jones 6447* (MBG, P); Moscow, Latah Lake, June, 1900, *Abrams 701* (P); region of Coeur d'Alene Mts., alt. 640 m., Aug. 17, 1895, *Leiberg 1546* (P); Moscow Mts., along road, June 28, 1925, *Eastwood 13363* (P); Selway Forest, between Elk Summit and Kooskooska Meadows, alt. 7000 ft., Aug. 15, 1923, *Kirkwood 1594* (Epling Herb.); Revett Lake, alt. 5000–6000 ft., Aug. 10, 1926, *Epling, Houck & Putnam 10119* (Epling Herb.); Moyie Springs, Aug. 30, 1926, *Epling 10426* (Epling Herb.); Beaver Creek, Bonner Co., June 29, 1925, *Witham 8990* (Epling Herb.); Bonner Co., common, open brush land, May 24, 1925, *Witham* (Epling Herb.); Priest Lake, Aug., 1901, *Piper 3786* (Epling Herb.); Thatuna Hills, July 4, 1926, *Epling & Houck* (Epling Herb.).

Utah: Wasatch Mts., July, 1869, alt. 6500 ft., *Watson 957* (G); Wasatch Mts., 1877, *Hooker & Gray* (G); Salt Lake City, 1872, *Engelmann* (MBG); East Bountiful, Sept. 22, 1909, *Clemens* (P); City Creek Canyon, Sept. 11, 1880, *M. E. Jones* (P); same locality, June 29, 1880, *M. E. Jones* (P).

Nevada: King's Canyon, Ormsby Co., alt. 1700–2000 m., June 21, 1902, *Baker 1122* (US, MBG, G, P, NY, F); on mountain slopes west of Carson City, elev. 1800 m., July 5, 1919, *Tidestrom 10255* (NY, US, G); Little Valley, Washoe Co., alt. 2000–2500 m., Aug. 14, 1902, *Baker 1461* (B, P, MBG, ND, US, NY); Hunter's Creek, Washoe Co., elev. 6000 ft., Aug. 2, 1912, *P. P. Kennedy 1916* (G, NY); Verdi, July 28, 1893, *Hillman* (P).

Washington: Bingen, Klickitat Co., steep mountainside, June 9, 1905, *Suksdorf 5133* (MBG, US, G, NY); Waitsburg, May 29, 1897, *Horner 334* (G); valley of the Swank River, Kittitas Co., May–Sept., 1913, *Sharples 181* (G); Bingen, dry open forest, May 23, 1924, *Suksdorf 11692* (G, W); Lake Chelan, Cascade Mts., alt. 1090 ft., July 1–Sept. 15, 1915, *Kammerer 103*

(MBG); Klamath Co., south side Devil's Peak, Cherry Creek Canyon, alt. 6500 ft., Aug. 15, 1909, *J. P. Rose 1382* (MBG); Pullman, July 25, 1900, *Piper 3508* (US, G).

Oregon: common in old fields and open hillsides, Hood River Co., May 18, 1924, *Henderson 310* (MBG); five miles east of Union Creek, July 24, 1918, *Heller 13067* (MBG, US, NY, G, F); Klamath Valley, alt. 4200 ft., 1864, *Cronkhite 76* (US, MBG); The Dalles, alt. 100 ft., July 27, 1897, *M. E. Jones* (P); Josephine Co., near Stone Corral, west fork of Illinois River, July 1–3, 1922, *Abrams 8629* (P); Takilma, Josephine Co., June 26, 1918, *Peck 8004* (G); Swan Lake Valley, Klamath Co., July 8, 1896, *Applegate 447* (G); Columbia Plains, *Nuttall* (G); Grant's Pass, June 5, 1912, *Prescott* (G).

California: Hornbreck, Siskiyou Co., July 7, 1903, *Copeland 3544* (P, MBG, US, G); Brush Creek, Butte Co., 1907, *Conger* (P); Hockett's Meadows, Tulare Co., July 1, 1904, *Culbertson 4472* (MBG, G, P, US); San Bernardino Mts., north fork Deep Creek, alt. 6200 ft., under pines, July 17, 1921, *Johnston 2871* (P); Bear Lake, San Bernardino Mts., June 24, 1926, *M. E. Jones* (P); Pine Grove, Amador Co., alt. 2200 ft., July 20, 1895, *G. Hanson 938* (US, MBG, G, P, NY, F); Mt. Shasta and vicinity, Siskiyou Co., July 13–29, 1892, *E. Palmer 2522* (P, US); Bear River, Amador Co., alt. 5500 ft., July 30, 1896, *G. Hanson* (P, US, MBG, G); Lake Tahoe, woods along shore, Aug. 4, 1920, *Keyes* (P); north fork Coffee Creek, Trinity Co., alt. 4500 ft., July 3, 1911, *Alexander & L. Kellogg 209* (P); Mt. Silliman, Aug. 1905, *K. Brandegee* (P); Silver Lake, Amador Co., alt. 8000 ft., Oct. 1893, *G. Hanson 969* (MBG, US); near Pit River Ferry, Shasta Co., alt. 700–900 ft., May 15–28, 1897, *H. E. Brown* (MBG, NY); between Meek's Bay and Emerald Bay, Lake Tahoe, July 30, 1919, *Heller 13345* (MBG); Pine Ridge, Fresno Co., alt. 5300 ft., June 15–25, 1900, *Hall & Chandler 146* (MBG, NY, ANSP); west of Bennett Springs, Glenn Co., June 16, 1915, *Heller 11986* (MBG); Long Valley, June 7, 1869, *Kellogg & Harford 4870* (MBG); Summit Station, Placer Co., date lacking, *Heller 12887* (MBG); Lassen Creek, Modoc Co., 1894, *Austin* (ND); Davis Creek, Modoc Co., 1895, *Austin* (ND); Murphy's, Calaveras Co., May 15, 1887, *B. H. Smith* (ANSP); Modoc

Co., hillsides, red soil, July 12, 1893, *M. S. Baker* (ND, NY, MBG); Carver Creek, Aug. 4, 1882, *Austin* (ND); Blue Canyon, July 21, 1895, *Greene* (ND, US); Plumas Co., July, 1882, *Austin* (ND); Glen Alpine, Aug. 19, 1909, *McGregor 32* (NY, US); Willits, Mendocino Co., July 7, 1923, *Heller 13753* (NY); Rush Creek, Trinity Co., June, 1914, *Yates* (NY); Wolf Creek, Mendocino Co., July 7, 1916, *Abrams 5865* (NY); Truckee, July 17, 1901, *Williamson* (ANSP).

2a. **Apocynum pumilum** (A. Gray) Greene var. **rhomboideum** (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 98. 1913. Plate 10.

Apocynum rhomboideum Greene, Pittonia **5**: 66. 1902.

Apocynum tomentellum Greene, Leafl. Bot. Obs. & Crit. **1**: 58. 1904, *non* Nieuwl.

Apocynum androsaemifolium L. subsp. *detonsum* Piper, Contr. U. S. Nat. Herb. **11**: 453. 1906.

Apocynum cinereum A. A. Heller, Muhlenbergia **8**: 21. 1912.

Apocynum polycardium Greene, Leafl. Bot. Obs. & Crit. **2**: 184. 1912.

Apocynum pulchellum Greene, *l. c.* 186. 1912.

Apocynum arcuatum Greene, *l. c.* 187. 1912.

Apocynum diversifolium Greene, *l. c.* 189. 1912.

Apocynum pumilum (A. Gray) Greene var. *intermedium* Bég. & Bel. *l. c.* 96. 1913.

Apocynum pumilum (A. Gray) Greene var. *tomentellum* (Greene) Bég. & Bel. *l. c.* 1913.

Apocynum molle Greene *ex* Bég. & Bel. *l. c.* 97. 1913, *nomen in synon.*

Apocynum ericifolium Greene *ex* Bég. & Bel. *l. c.* 1913, *nomen in synon.*

Apocynum pumilum (A. Gray) Greene var. *pulchellum* (Greene) Bég. & Bel. *l. c.* 98. 1913.

Plant variously tomentose or pubescent, in all other essential characters similar to the type.

Distribution: apparently limited to the Pacific Coast area of the United States.

Specimens examined:

Idaho: about Lake Waha, Nez Perces Co., alt. 3500–4000 ft., June 29, 1896, *Heller & Heller 3338* (MBG, US, NY).

Nevada: King's Canyon, Ormsby Co., alt. 1700–2000 m., July 1, 1902, *Baker 1209* (MBG, P, US, G, NY, ND, F, W); Clear Creek, Ormsby Co., alt. 2000–2615 m., July 3, 1902, *Baker 1252*, in part (P).

Washington: locality missing, 1889, *Vasey 429* (G, W); Falcon Valley, open woods, July 19, Sept., 1886, *Suksdorf* (G, US, NY); Bingen, dry mountain-sides, June 9, 1905, *Suksdorf 5134*, in part (G, US, MBG); Mt. Ellinor, Olympia Mts., Aug., 1910, *Zeller* (MBG); top, Mt. Constitution, July 5, 1907, *Cowles 380* (MBG); Lake Washington, King Co., June 20–July 12, 1898, *Savage, Cameron & Lenocker* (MBG); prairie, Sequim, June 12, 1915, *Grant* (MBG, NY).

Oregon: Wimer, Jackson Co., July 14, 1892, *Hammond 274* (P, US, ANSP); two miles north of Mt. Hood post-office, Hood River Co., July 25–28, 1922, *Abrams 9338* (P); Big Butte Creek, Josephine Co., Sept. 3, 1917, *Heller 12963* (G, MBG, NY, F); Anchor, Douglas Co., Aug. 14, 1916, *Peck 2945* (G, US); locality and date lacking, *Hooker* (G); Salem, July 8, 1917, *J. C. Nelson 1594* (G); Port Oxford, dry ridge, Bald Mt., July 26, 1919, *Peck 8944* (G, MBG, NY); Columbia Plains, date lacking, *Nuttall* (G); Hillsboro, Dairy Creek Valley, railroad tracks, July 11, 1915, *H. H. Smith 6013* (F); locality lacking, 1871, *E. Hall 427* (G, MBG); near the Dalles on the Columbia River, Aug. 16, 1916, *Soper* (MBG).

California: Alder Springs, Glenn Co., July 4, 1917, *Heller 12753* (G, MBG); Palomar Mt., San Diego Co., alt. 5000 ft., June 22, 1924, *Munz 8274* (P, G); Yosemite Valley, June 30, 1911, *Abrams 4580* (G, P); Thistle Glade, Lake Co., Aug. 6, 1902, *Heller 6036* (G, P, US); Glenn Co., June 16, 1915, *Heller 11978* (G, MBG, NY, ANSP, US, F); Fredalba, San Bernardino Co., July 22, 1902, *Abrams 2775* (US, G, P, ANSP, F, MBG); Mt. Sanhedrin, near the summit, Lake Co., July 20, 1902, *Heller* (US, G); Sisson, Siskiyou Co., Nov. 12, 1913, *L. E. Smith 571* (G); above Donner Lake toward Donner Pass, Nevada Co., July 29, 1903, *Heller 7050* (P, NY, ANSP, US, MBG); Diamond Mt., Susanville, Perkin's Ranch, alt. 6000–7000 ft., June 28,

1897, *M. E. Jones* (P); dry slopes, Palomar Mt., San Diego Co., alt. 5000 ft., *Munz 8274* (P); Soda Springs, Nevada Co., alt. 7000 ft., July, 1881, *M. E. Jones* (P); Lassen Co., July 30, year lacking, *Austin 1458* (US); Smith Mt., San Diego Co., July 5, 1896, *McClatchie* (NY); south fork of the Eel River, July 8, 1892, *Jepson* (ND); Mt. Hamilton, July, 1891, *Greene* (ND).

3. **Apocynum medium** Greene, Pittonia **3**: 230. 1897; G. S. Miller, Proc. Biol. Soc. Wash. **13**: 84. 1899; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 662. 1908; Stone, Pl. South. N. J. 646. 1911; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 121. 1913; Britton & Brown, Ill. Fl. ed. 2, **3**: 21. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. **21**: 230. 1919; Pease, Vasc. Fl. Coös Co. N. H. 324. 1924. Plate 11.

Apocynum speciosum G. S. Miller, Proc. Biol. Soc. Wash. **13**: 83. 1899; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 122. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. **21**: 230. 1919.

Apocynum urceolifer G. S. Miller, *l. c.* 1899.

Apocynum androsaemifolium Holm *ex* G. S. Miller, *l. c.* 1899, *non* L.

Apocynum Milleri Britton, Man. Pl. 739. 1901; Britton & Brown, Ill. Fl. ed. 2. **3**: 22. 1913.

"*Apocynum medium* G. S. Miller," *ex* Britton, Man. Pl. 739. 1901, *non* Greene.

Apocynum divergens Greene, Leafl. Bot. Obs. & Crit. **1**: 56. 1904.

Apocynum Andrewsii Greene, *l. c.* 57. 1904.

Apocynum abditum Greene, *l. c.* **2**: 105. 1910.

Apocynum insigne Greene, *l. c.* 178. 1912.

Apocynum ellipticum Greene, *l. c.* 179. 1912.

Apocynum Elmeri Greene, *l. c.* 181. 1912.

Apocynum pumilum (A. Gray) Greene var. *Milleri* (Britton) Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 96. 1913.

Apocynum macrophyllum Bég. & Bel. *l. c.* 123. 1913.

Apocynum pseudomedium Bég. & Bel. *l. c.* 124. 1913.

Apocynum lividum Greene var. *Elmeri* (Greene) Bég. & Bel. *l. c.* 127. 1913.

Apocynum lividum Greene var. *abditum* (Greene) Bég. & Bel. *l. c.* 128. 1913.

Apocynum androsaemifolium L. var. *Andrewsii* (Greene) Bég. & Bel. *l. c.* 85. 1913.

Apocynum androsaemifolium L. var. *oblongifolium* Bég. & Bel. *l. c.* 85. 1913. *nomen in synon.*

Apocynum coconinum Greene ex. Bég. & Bel. *l. c.* 129. 1913. *nomen in synon.*

Apocynum viride Wooton & Standl. Contr. U. S. Nat. Herb. **16:** 159. 1913.

Apocynum Milleri Britton var. *pauciflorum* Farwell, Rept. Mich. Acad. Sci. **17:** 170. 1916.

Stems erect or ascending, 2–5 dm. tall, freely and rather dichotomously branched, branches ascending, alternate to subopposite, glabrate; leaves opposite, petiolate to subsessile, spreading, ovate to oblong-lanceolate, acute to obtuse at base and apex, or cordate-obovate, membranaceous, entire, mucronate, pubescent or tomentulose, at least beneath; corolla campanulate, 4–5 mm. long, 3.5–5 mm. broad at the orifice, the base of the tube less than one-half the breadth of the limb, the limb slightly spreading, calyx-lobes lanceolate to oblong, 1.5–3 mm. long, tomentulose or glabrate, colorless or slightly tinted; follicles 7–15 cm. long, straight, divergent, or somewhat falcate, pendulous, coma of seeds 2 cm. long, pale tawny, seeds cylindrical, 4 mm. long.

Distribution: generally throughout the range of *A. androsaemifolium.*

Specimens examined:

NEWFOUNDLAND: ledges, talus and gravel, north bank of Exploits River, below Bishop Falls, July 28, 1911, *Fernald & Wiegand 6090* (G); Grand Falls, July 27, 1911, *Fernald & Wiegand 6089* (G).

CANADA:

NOVA SCOTIA: slaty ledges and cobbly upper beach of Shubenacadie, Grand Lake, July 19, 1920, *Fernald & Bissell 22316* (G); Wentzell Lake, Aug. 17, 1921, *Fernald & Long 24392* (G).

NEW BRUNSWICK: sandy river bank, Westfield, Aug. 8, 1909, *Fernald 2075* (G); gravelly river thickets and bushy terraces, Woodstock, July 14, 1916, *Fernald & Long 14400* (G).

QUEBEC: Matapedia, ledgy banks of the Restigouche River, July 19, 1904, *Collins & Fernald* (G); Grand Cascapedia River,

alluvium, July 12–15, 1904, *Williams, Collins & Fernald* (G); Saint-Laurent; remblai du chemin de fer, Juillet 5, 1926, *Adrien 1094* (G); Grande Rapide, River Ste. Anne des Monts, Aug. 3–17, 1905, *Collins & Fernald* (G).

United States:

Maine: Fort Fairfield, alluvial thicket, July 16, 1902, *Williams, Collins & Fernald* (G); Fort Kent, July 24, 1900, *Williams* (G, US); Orne Falls, in granite ledges, July 17, 1900, *Williams & Fernald* (G, MBG, US); Rumford, 1889, *Parlin* (G); Van Buren, dry wooded bank, July 26, 1893, *Fernald* (G); river-beach below Fort Kent, July 15, 1908, *Churchill* (NE); Grand Falls, east branch of the Penobscot River, July 28, 1857, *Hoar* (NE); argillaceous ledges by river, Winn, July 10, 1916, *Fernald & Long 14399* (NE, ANSP); Orono, 1880, *Furbish* (NE); East Livermore, bank of the Androscoggin River, July 26, 1901, *Eaton* (NE).

New Hampshire: Dalton, gravelly shore of Connecticut River, July 7, 1919, *Pease 17383* (NE).

Vermont: Westminster, open ground, sandy soil, June 16, 1898, *B. L. Robinson 11* (G); Willoughby, July 11, 1895, *G. G. Kennedy* (NE); Westmore, Aug. 1919, *Winslow* (NE); Swanton, Franklin Co., alt. 125 ft., Aug. 17, 1911, *Blake 2844* (NE); Brattleboro, July 10, 1916, *Wheeler 2* (NE).

Massachusetts: Edgartown, Martha's Vineyard, June 22, 1913, *Bicknell* (NY); river-bank, Shelburne Falls, Franklin Co., July 21, 1921, *Churchill* (MBG, G, NY, US); South Framingham, July 30, 1908, *Wiegand & Hentley* (NE); Dorchester, July 15, 1899, *Churchill* (NE); Brewster, dry woods near Namskaket Creek, July 22, 1919, *Fernald & Long 19008* (G, ANSP); West Yarmouth, brook-side, Aug. 1, 1907, *Sinnott* (NE); Great Barrington, July 17, 1920, *Hoffmann* (NE); West Tisbury, Sept. 5, 1917, *Seymour 1431* (NE); Wilmington, bridge at canal crossing, July 22, 1910, *G. G. Kennedy* (G).

Rhode Island: Scituate, July 21, 1920, *Collins & Hope* (NE); Block Island, Great South Pond, Aug. 22, 1913, *Fernald, Hunnewell & Long 10243* (NE).

Connecticut: New Haven, 1859, *Eaton* (MBG); Groton, Poquomoc Plain, Aug. 16, 1903, *Graves* (G); Southington, Whitney's Garden, July 4, 1904, *Andrews* (NE); Southington,

sandy loam in open grass-land, Aug. 1, 1902, *Andrews* (NE, US); Killingly, dry rock ledges, June 22, 1902, *Bissell* (NE); New London, July 5, 1903, *Graves* (G); Westport, July 1, 1914, *Eames 8786* (G); South Windsor, roadside in heavy soil, July 21, 1918, *Weatherby 4324* (NE).

New York: Lime Kiln Falls, July 6, 1906, *Rydberg 7892* (NY); Deerfield, banks of the Mohawk River, Oneida Co., July 18, 1912, *Haberer 3559* (ND, NY); Ithaca, Six Mile Creek, July 21, 1915, *Eames & McDaniels 4832* (G); Penn Yan, date lacking, *Sartwell* (G); Hempstead, July 3, 1904, *Churchill* (G, US); Riverhead, dry sandy roadside, July 27, 1920, *H. St. John 2880* (G).

New Jersey: New Brunswick, July, 1891, *G. G. Kennedy 50* (G); Newton, July 14, 1907, *Carter* (ANSP); Culver's Gap, July 12, 1907, *Williamson* (ANSP).

Pennsylvania: mountain near Reading, Aug. 6, 1909, *Williamson* (ANSP); Morrisville, July, 1892, *Kelsey 158* (G); Cove Valley, Aug., 1824, *Beyerich* (MBG); Mt. Alto, 1909, *Illick* (MBG).

Maryland: Capitol View, Montgomery Co., June 21, 1899, *Miller 2* (G, US); Capitol View, July 2, 1899, *Miller 1* (G, US); Sligo, July 9, 1899, *Miller 3* (G, US).

District of Columbia: Washington, July 23, 1898, *Steele* (G); Brookland, abundant in low grounds, July 4, 1893, *Holm* (G, US); Brookland, July 3, 1909, *Greene* (ND, US).

Virginia: Chain Bridge, July 14, 1899, *W. Palmer* (US); near Coral, Fairfax Co., Aug. 14, 1905, *Bartsch* (MBG).

Florida: Lake City, date lacking, *Rolfs 720* (MBG).

Ohio: near Cincinnati, July 17, 1882, *Lloyd* (MBG).

Michigan: Detroit, hillsides, June, 1904, *Farwell* (US); Ionia, 1877, *E. F. Smith* (G); between Battle Creek and Jackson, on roadside banks in clay soil, Aug. 22, 1926, *Heller 14261* (MBG).

Indiana: Lake Cicott, July 22, 1915, *Deam 17879* (G, US, NY, D); Notre Dame, Indian Grove, Oct. 8, 1913, *Nieuwland 11602* (MBG, F); St. Joe, June 29, 1916, *Deam 21571* (G, D); in wooded lot across railway from Notre Dame University, June 29, 1928, *Nieuwland, Slavin & Woodson 1* (MBG); in dry soil along the right-of-way of the Penna. Railroad, 2 mi. east of

Burnettsville, Cass Co., July 9, 1918, *Deam 25904* (D); Warren Co., along road 2 mi. southeast of Williamsport, Aug. 1, 1912, *Deam 11902* (D); Blackford Co., Washington Tp., Sec. 30, on west side of swale, northeast of glycerine factory, July 16, 1905, *Deam 73* (D); Tippecanoe Co., near Lafayette, very common along Wabash Ry., July 4, 1901, *H. B. Dorner* (D); wooded slope of Elizabeth Hill, about 3 mi. east of Elizabeth, Harrison Co., June 11, 1919, *Deam 27862* (D); moist woods on north side of Lake Wawasee, Kosciusko Co., June 22, 1908, *Deam* (D).

ILLINOIS: Peoria, July, 1903, *McDonald* (NY).

TENNESSEE: Franklin, Cumberland Mt., July 21, 1897, *Eggert* (MBG).

IOWA: Muscatine, July 14, 1894, *Mackenzie* (NY).

MISSOURI: Ethel, June 12, 1915, *Bush 7615* (NY, MBG); Mansfield, alt. 1450 ft., June 12, 1911, *Lansing 3183* (G, F); Joplin, rocky wooded hillsides, *E. J. Palmer 18293* (NY, MBG); Vernon Co., date lacking, *Broadhead* (MBG); Montier, common, June 30, 1894, *Bush 338* (MBG).

NEBRASKA: Monroe Canyon, June 20, 1911, *Pool & Williams* (MBG).

TEXAS: exact locality lacking, March 28, 1874, *Reverchon* (MBG); on gravel-bank of stream, near Boot Spring, Chisos Mts., Brewster Co., May 25, 1928, *E. J. Palmer 3418a* (MBG).

NEW MEXICO: exact locality lacking, 1847, *Fendler 690.6* (MBG); Lincoln Co., White Mts., Aug. 25, 1907, *Wooton & Standley 3451* (US); infrequent, sandy soil, Flagstaff, alt. 7000 ft., Aug. 11, 1922, *H. C. Hanson 158* (MBG).

3a. Apocynum medium Greene var. **sarniense** (Greene) Woodson, n. comb.

Apocynum Sarniense Greene, Leafl. Bot. Obs. & Crit. **2:** 167. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. **9:** 123. 1913.

Apocynum griseum Greene, *l. c.* 181. 1912.

Apocynum androsaemifolium L. var. *griseum* (Greene) Bég. & Bel. *l. c.* 87. 1913.

Corolla hirtellous without; upper surface of leaves softly pubescent, or occasionally glabrate; in all other essential characters similar to the species.

Distribution: apparently a spontaneous variety, collected in southwestern Ontario, southeastern Michigan, northern Indiana, and southern British Columbia.

Specimens examined:

Canada:

Ontario: Sarnia, Lambton Co., Aug. 3, 1902, *Dodge* (US).

British Columbia: near international boundary between Kettle and Columbia Rivers, June 6, 1902, *Macoun 66555* (US, ND).

United States:

Michigan: Detroit, July 13, 1889, *Suttie* (MBG).

Indiana: sandy roadside 9 mi. west of Howe, La Grange Co., Sept. 21, 1916, *Deam 20972* (D); in hard clay soil along a roadside, 1 mi. north of Poling, Jay Co., July 19, 1923, *Deam 39168* (D); on the break of a bluff in a deep white and black oak woods about 1 mi. northwest of St. Joe, Clark Co., June 29, 1916, *Deam 20571* (D).

3b. Apocynum medium Greene var. **leuconeuron** (Greene) Woodson, n. comb.

Apocynum leuconeuron Greene, Leafl. Bot. Obs. & Crit. 2: 178. 1912.

Plant glabrous throughout, calyx-lobes oblong to ovate, abruptly acute, colorless; in all other essential characters similar to the species.

Distribution: the upper Mississippi Valley, eastward to southern Michigan and northern Indiana.

Specimens examined:

United States:

Michigan: peat swamp—Tamarack, *Lilium michiganense*, etc.,—Flowerfield, south of Schoolcraft, July 14, 1929, *E. Anderson* (MBG).

Indiana: sandy roadside 3 mi. southwest of Elkhart, Elkhart Co., July 2, 1921, *Deam 34434* (D).

Wisconsin: Oshkosh, July 30, 1909, *Clemens* (P).

Missouri: Clarksville Depot, Pike Co., June 16, 1914, *J. Davis 2263* (MBG); Jackson Co., clayey hills, only found near Little Blue as yet, June 24, 1884, *Bush 916* (MBG, US); Jerome, May

24, 1914, *Kellogg 471* (MBG); east of Mt. Olivet Cemetery, Hannibal, Marion Co., waste fields, July 21, 1914, *J. Davis 2969* (MBG); Cockerell, July 3, 1898, common in barrens, *Bush 11* (MBG, US); Hannibal, Marion Co., Aug. 21, 1914, ravine, *J. Davis 2947* (MBG); Jackson Co., loose sand-banks, July 3, 1898, *Mackenzie 200* (MBG, NY); northeast corner of Mt. Olivet Cemetery, Hannibal, Marion Co., July 23, 1927, *Woodson & Fuller 1653* (MBG); Clarksville, Pike Co., railroad bank, opposite station, July 23, 1927, *Woodson & Fuller 1696* (MBG).

3c. Apocynum medium Greene var. **floribundum** (Greene) Woodson, n. comb. Plate 12.

Apocynum floribundum Greene, Erythea **1**: 151. 1893.

Apocynum viarum Heller, Muhlenbergia **2**: 110. 1906.

Apocynum cannabinum L. var. *lividum* A. Nels. in Coulter & Nels. New Man. Bot. Rocky Mts. 386. 1909.

Apocynum glaucum Nieuwl. Am. Mid. Nat. **2**: 181. 1912.

Apocynum vacillans Greene, Leafl. Bot. Obs. & Crit. **2**: 180. 1912.

Apocynum rubicundum Greene, *l. c.* 182. 1912.

Apocynum pumilum (A. Gray) Greene var. *rubicundum* (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 127. 1913.

Apocynum lividum Greene var. *vacillans* (Greene) Bég. & Bel. *l. c.* 127. 1913.

Apocynum lividum Greene var. *floribundum* (Greene) Bég. & Bel. *l. c.* 128. 1913.

Apocynum lividum Greene var. *viarium* (Heller) Bég. & Bel. *l. c.* 129. 1913.

Plant completely glabrous; corolla cylindrical, the tube conspicuously longer than the spread of the limb; in all other essential characters similar to the species.

Distribution: Colorado and westward in the United States.

United States:

Texas: Guadalupe Mts., Aug. 19, 1901, *Bailey 444* (US); moist banks about spring, Juniper Canyon, Chisos Mts., Brewster Co., May 22, 1928, *E. J. Palmer 34081* (MBG).

Montana: bluffs, Midvale, July 14, 1903, *Umbach 371* (US, NY);

Mecksville, in the Clarkes Fork Valley, Aug. 22, 1895, *Leiberg* (US, MBG); Spanish Creek, Gallatin Co., 1901, *Vogel* (G); Ravalli, July 14, 1909, *M. E. Jones* (P).

Wyoming: rolling plains between Sheridan and Buff, elev. 3500–5000 ft., July 15, 1900, *Tweedy 3475* (W).

Colorado: Piedra, July 11, 1899, *Baker 526* (G, US, NY); Clear Creek Canyon, June 20, 1878, *M. E. Jones 237* (P); Clear Creek Canyon, July 18, 1896, *Crandall* (NY); in loose clay, Boulder, Boulder Co., June 27, 1913, *Vestal* (MBG); plains, Boulder, alt. 5400 ft., July 19, 1906, *Daniels 409* (MBG); common in woods along creek, Boulder, alt. about 5300 ft., Aug. 2, 1921, *H. C. Hanson 277* (MBG); base of Palisade Mt., Larimer Co., alt. 8000 ft., Aug. 10, 1927, *Woodson 1809* (MBG); among rocks below Eagle Cliffs, Moraine Park, Larimer Co., July 25, 1929, *Woodson & Barnhart 29030* (MBG).

New Mexico: Round Mound, June 19, 1846, *Wislizenus 496* (MBG); Ute Park, Colfax Co., Aug. 29, 1916, *Standley 13989* (NY, US); Copper Mines, July, 1851, *Thurber 222* (NY); in the Organ Mts., Dona Ana Co., alt. 6300 ft., July 8, 1897, *Wooton 113* (MBG, US).

Idaho: Weeksville, Clarkes Fork Valley, alt. 650 m., Aug. 22, 1895 (labelled "*Chrysopsis villosa* (Pursh) Nutt."), *Leiberg 1565* (MBG, G); Lake Coeur d'Alene, Aug. 3–4, 1925, *Epling & Houck 10004* (Epling Herb.); Clearwater, date lacking, *Epling & Houck 9402* (Epling Herb.); Bonner's Ferry, Aug. 30, 1926, *Epling 10461* (Epling Herb.).

Utah: Moab, June 9, 1913, *M. E. Jones* (P); Parley's Canyon, June 17, year lacking, *Garrett 2915* (NY).

Arizona: Ft. Apache, June, 1893, *Hoyt* (NY); Flagstaff, vicinity, alt. 7000 ft., July 8, 1898, *MacDougal 254* (G); frequent, sandy places west of Flagstaff, June 27, 1923, *Hanson 585* (MBG); Williams, July 5, 1889, *Greene* (ND).

Nevada: King's Canyon, Ormsby Co., Aug. 20, 1902, *Baker 1508* (MBG, G, US, NY, F); same locality, July 3, 1902, *Baker 1220* (P, MBG); mountains west of Carson, Washoe Co., July 13, 1909, *Heller 9815* (MBG, G, NY, US); Verdi, elev. 5300 ft., Washoe Co., June 30, 1913, *Heller 10883* (NY).

WASHINGTON: locality lacking, 1889, *Vasey 430* (G, US, W); among rocks, rare, Guy, Whitman Co., July 18, 1896, *Elmer 285* (MBG, US, P, W); Peshashtin, Okanogan Co., 1500 ft., July 25, 1893, *Sandberg & Leiberg 591* (W); near Wenatchee, Aug. 11, 1901, *Whited 1423* (W).

OREGON: dry soil along railroad, 1 mile south of Brooks, Marion Co., June 29, 1918, *J. C. Nelson 2284* (G); Rogue River, Aug. 27, 1897, *Austin 1683* (P); dry slope, Canyon City, July 12, 1921, *Peck 10172* (P).

CALIFORNIA: near Healdsburg, June, 1897, *King 247* (P); Nevada City, July 14, 1905, *Heller 8110* (MBG, G, US, NY, W); Goose Valley, Shasta Co., June 29, July 11, 1912, *Eastwood 906* (G, MBG, US); Yosemite Valley, alt. 4000–4500 ft., July 9, 1911, *Abrams 4650* (G); Mt. Tallac, Tahoe, alt. 8600 ft., July 19, 1913, *Smiley 247* (G); Nevada City, Nevada Co., June 20–22, 1912, *Eastwood 542* (MBG); Amador Co., alt. 2000 ft., July, 1891, *G. Hanson 27* (MBG); Tehachapi, June 22, 1889, *Greene* (US, ND).

MEXICO: near Colonia Garcia, June 23, 1899, *Townsend & Barber* (US); in the Sierra Madre, Chihuahua, June 21–July 29, 1899, *E. W. Nelson 6012* (US).

3d. **Apocynum medium** Greene var. **lividum** (Greene) Woodson, n. comb.

Apocynum lividum Greene, Pl. Baker. **3**: 17. 1901; Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies 2^2: 193. 1911; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 125. 1913; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 505. 1915; Rydb. Fl. Rocky Mts. 669. ed. 2. 1917; Tidestrom, Contr. U. S. Nat. Herb. **25**: 419. 1925.

Apocynum ciliolatum Piper, Contr. U. S. Nat. Herb. **11**: 453. 1906; Frye & Rigg, Northwest. Fl. 308. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 130. 1913; Piper & Beattie, Fl. S. E. Wash. 194. 1914.

Apocynum lividum Greene var. *typicum* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 95. 1913.

Apocynum denticulatum Suksdorf, Werdenda **1**: 31. 1927.

Plant glabrous except the under surface of the leaves; calyx-

lobes ciliate-erose; in all other essential characters similar to the species.

Distribution: Colorado and northern New Mexico, westward to Washington and California.

Specimens examined:

Colorado: Black Canyon, alt. 6800 ft., July 8, 1901, *Baker 372* (G, MBG, US, NY, P, W); Mancos, July 9, 1898, *Baker, Earle & Tracy 429* (G, MBG, US, NY, P); stream banks, North St. Vrain Canyon, near "the Narrows," Larimer Co., July 25, 1929, *Woodson & Barnhart 29028* (MBG); stream banks, near mouth of North St. Vrain Canyon, west of Lyons, July 9, 1929, *Woodson & Anderson 29001* (MBG); flourishing in cultivated fields and irrigation ditches, Bayfield, La Plata Co., June 27, 1929, *Woodson & Anderson 29007* (MBG).

New Mexico: along roadsides, near summit of Raton Pass, June 30, 1929, *Mathias 536* (MBG).

Washington: Wawawai, July 17, 1892, *Lake & Hull 542* (US); Rockland, on steep dry hillside near a small stream, June 8, 1904, *Suksdorf 4049* (G, W).

California: Yosemite Valley, alt. 4000–4500 ft., June 28, 1911, *Abrams 4549* (P); Big Bear Valley, pine-covered hillside, alt. 7000 ft., July 5, 1920, *Harwood 4328* (P).

3e. Apocynum medium Greene var. **vestitum** (Greene) Woodson, n. comb. Plate 13.

Apocynum vestitum Greene, Man. Bay Region Bot. 240. 1894; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 131. 1913.

Apocynum incanum Greene, Leafl. Bot. Obs. & Crit. **2**: 164. 1911; Bég. & Bel. *l. c.* 130. 1913. *non* (A. DC.) G. S. Miller.

Entire plant pubescent; corolla cylindrical; calyx-lobes entire; in all other essential characters similar to the species.

Distribution: southern Oregon and north-central California.

Specimens examined:

Oregon: Rogue River, Bolt, Jackson Co., July 8, 1892, *Hammond 275* (MBG, US, NY).

California: St. Helena, July, 1891, *Greene* (ND, US); Napa Co., dry creek, May 12, 1895, *Greene* (ND, US).

4. **Apocynum Jonesii** Woodson, n. sp.[97] Plate 14.
Stems erect or somewhat ascending, 5–6 dm. tall, freely and somewhat fastigiately branched, the branches opposite to subopposite, glabrous throughout; leaves relatively small, petiolate, lanceolate-oblong, 3–5 cm. long, 1–2 cm. broad, acute at base and apex, membranaceous, entire, mucronate; inflorescence strictly cymose, few-flowered, terminal, or rarely axillary; corolla cylindrical, 2.5–3 mm. long, 2 mm. broad at the orifice, the base of the tube about equalling the breadth of the orifice, limb erect, glabrous; calyx-lobes ovate, .75–1.0 mm. long, glabrous, entire, pinkish; follicles unknown.

Distribution: known only from the type locality in Arizona.

Specimen examined:

ARIZONA: Flagstaff, Aug. 12, 1884, *M. E. Jones* (P, TYPE).

This species, which is most nearly related to *A. Suksdorfii*, is very distinct by reason of its calyx and its corolla, as set forth in the preceding key to the species of the genus. It is dedicated to Professor Marcus E. Jones, the collector of the type specimen.

5. **Apocynum Suksdorfii** Greene, Pittonia **5**: 65. 1902; Piper, Contr. U. S. Nat. Herb. **11**: 453. 1906; Frye & Rigg, Northwest Fl. 308. 1912. Plate 15.

Apocynum laurinum Greene, *l. c.* 1902; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 129. 1913; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 506. 1915.

Apocynum oliganthum Greene, Leafl. Bot. Obs. & Crit. **1**: 58. 1904.

Apocynum myrianthum Greene, *l. c.* 59. 1904.

Apocynum cannabinum L. var. *oliganthum* (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 104. 1913.

Apocynum cannabinum L. var. *Suksdorfii* (Greene) Bég. & Bel. *l. c.* 105. 1913.

Apocynum hypericifolium Ait. var. *myrianthum* (Greene) Bég. & Bel. *l. c.* 118. 1913.

[97] **Apocynum Jonesii**, sp. nov., herbaceum perenne; caule erecto vel ascendente ramoso striato omino glabro; foliis oppositis petiolatis membranaceis oblongo-lanceolatis, mucronatis petiolatis; calycis lobis ovatis ca. 1 mm. longis; corolla cylindrica, tubo 2.5–3 mm. longo, limbo 5-partito, ca. 2 mm. lato folliculis ignotis.—Collected near Flagstaff, Arizona, Aug. 12, 1884, *M. E. Jones* (Pomona College Herb., TYPE).

Apocynum hypericifolium Ait. var. *pseudosuksdorfii* Bég. & Bel. *l. c.* 118. 1913.

"*Apocynum Suksdorfii* Elm. *non* Greene" ex Bég. & Bel. *l. c.* 1913, *nomen in synon.*

Stems erect or slightly ascending, 4–6 dm. tall, glabrous throughout, freely and somewhat fastigiately branched, the branches opposite to subopposite; leaves opposite, petiolate, oblong-ovate, 4–8 cm. long, 1.5–2.5 cm. broad, acute at both base and apex, membranaceous, entire, mucronate; corolla cylindrical, 2–3.5 mm. long, about 1.5–2 mm. broad at the orifice, the base of the tube about equalling the breadth of the orifice, limb erect; calyx-lobes lanceolate to oblong, 1–1.5 mm. long, entire, colorless or slightly tinted; follicles 9–10 cm. long, falcate, pendulous, seed 3.5–4 mm. long, coma of seed 2–2.5 cm. long, slightly tawny.

Distribution: generally throughout the Pacific Coast region, eastward to New Mexico and southern Colorado.

Specimens examined:

Colorado: New Windsor, Aug. 8, 1898, *Osterhout* (NY); steep rocky banks of Mancos River opposite mouth of Johnson's Canyon, Southern Ute Indian Reservation, Montezuma Co., June 27, 1929, *Woodson & Anderson 29075* (MBG).

Utah: Salt Lake City, July 16, 1880, alt. 4300 ft., *M. E. Jones 1863* (P).

Nevada: King's Canyon, Ormsby Co., alt. 1700–2000 m., Aug. 20, 1902, *Baker 1508*, in part (MBG, P); Humboldt Canyon, West Humboldt Mountains, Humboldt Co., elev. 5100 ft., July 31, 1912, *Heller 10612* (MBG, G, NY, F); Wadsworth, July 26, 1919, *Tidestrom 10727* (G, US); Palisade, Elko Co., elev. 5066 ft., Aug. 11, 1909, *Heller 9940* (G).

Arizona: Navajo Reservation, Nitsie C., a few dense patches, July, 1916, *Vorhies 44* (G, MBG, US, NY); Chevlon, w. of Holbrook, July 10, 1896, *Leick* (MBG); Reservoir Canyon, Painted Desert, plentiful, July 25, 1920, *Clute 87* (G, US); Willow Spring, June 10–20, 1890, *E. Palmer 511* (G).

Washington: Klickitat Co., high sandy bank of Columbia River, July 22, 1893, *Suksdorf 1522* (G, MBG, US, F); Wenatchee, date lacking, *Whited* (W); North Yakima, Aug., 1895, *Watt* (W).

Oregon: on rocks in North Fork of Umpqua River, between Rock Creek and Steamboat Creek, alt. 900–1200 ft., *Elmer* (US).

California: Waysides, Palomar Mt., San Diego Co., alt. 5600 ft., Aug. 14, 1918, *Spencer 995* (G, P).

5a. **Apocynum Suksdorfii** Greene var. **angustifolium** (Wooton) Woodson, n. comb.

Apocynum angustifolium Wooton, Contr. U. S. Nat. Herb. **16**: 159. 1913; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 506. 1915.

Apocynum hypericifolium Ait. var. *angustifolium* (Wooton) Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 120. 1913.

Apocynum pseudolaurinum Bég. & Bel. var. *typicum* Bég. & Bel. *l. c.* 1913, *nomen.*

Leaves lanceolate to linear-lanceolate; in all other essential characters similar to the species.

Distribution: New Mexico and southeastern Utah.

Specimens examined:

New Mexico: Gila River bottoms, near Cliff, Grant Co., June 13, 1903, *Metcalfe 132* (MBG, G, US, NY); Mimbres, Grant Co., July 1, 1904, *Metcalfe 1070* (G, MBG, P, US); near Pecos, San Miguel Co., alt. 6700 ft., Aug. 18, 1908, *Standley 5044* (MBG, US).

Utah: San Juan River, July 14, 1895, *Eastwood 71* (G).

6. **Apocynum cannabinum** L. Sp. Pl. ed. 1, 213. 1753; Michx. Fl. Bor. Am. **1**: 121. 1803; Pursh, Fl. Am. Sept. ed. 1, **1**: 179. 1814; Hook. Fl. Bor.-Am. **1**: 51. 1840; A. Gray, Bot. Cal. **1**: 473. 1876; Coulter, Man. Bot. Rocky Mts. 237. 1885; A. Gray, Syn. Fl. N. Am. **2**[1]: 82. 1886; Chapm. Fl. South. U. S. ed. 3, 341. 1897; Howell, Fl. N. W. Am. **1**: 439. 1901; Piper, Contr. U. S. Nat. Herb. **11**: 453. 1906; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 662. 1908; Small, Fl. Southeast. U. S. ed. 2, 936. 1913; Britt. & Brown, Ill. Fl. ed. 2, **3**: 22. 1913; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917; Tidestrom, Contr. U. S. Nat. Herb. **25**: 420. 1925; Garrett, Spring Fl. Wasatch Region, 120. 1927. Plate 16.

Apocynum platyphyllum Greene, Leafl. Bot. Obs. & Crit. **2**: 166. 1912.

Apocynum cannabinum L. var. *puberulum* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 101. 1913.

Apocynum cannabinum L. var. *incanum* Bég. & Bel. *l. c.* 1913.

Cynopaema cannabinum (L.) Lunell, Am. Mid. Nat. **4**: 509. 1916.

Stems erect or ascending, 3–6 dm. tall, glabrous, freely and somewhat fastigiately branched, branches ascending, opposite to sub-opposite; leaves opposite, petiolate, ovate to lanceolate, 4–10 cm. long, 1.5–4 cm. broad, acute to obtuse or rounded at both base and apex, membranaceous, entire, mucronate, glabrous above, tomentulose or pubescent beneath; inflorescence terminal, the bracts scarious, inconspicuous; corolla sphaerico-cylindrical, about as broad as long, 2–3 mm. long, 2–2.5 mm. broad, the limb erect; calyx-lobes lanceolate to ovate-oblong, 1.5–2 mm. long, entire, glabrous, scarious; follicles relatively long and subfalcate, 12–20 cm. long, pendulous, seeds 4–5 mm. long, coma of seed 2.5–3 cm. long, white.

Distribution: generally throughout the eastern half of the United States, infrequent in New England; a common field and roadside weed in the central states.

Specimens examined:

Vermont: banks of Connecticut River, cove below Bradford, Aug. 18, 1927, *Mathias 275* (MBG).

Massachusetts: Plymouth, date lacking, *Oakes* (G); Nonquit, July 14, 1888, *Sturtevant* (MBG); Chestnut Hill, Easton, *Porter* (US).

Rhode Island: Smithfield, July 23, 1845, *Olney* (G).

Connecticut: Bridgeport, July 8, 1895, *Eames* (G, US); Southington, sandy fields, frequent, July 10–Aug. 25, 1899, *Bissell* (NE); Stratford, July 25, 1894, *Eames* (NE); Milford, Aug. 9, 1893, *Eames* (NE); New Haven, 1859, *Eaton* (US).

New York: near Syracuse, 1891, *Straub* (US); Valley Head, July 18, 1898, *Ruth 501* (US).

Pennsylvania: Bradford Hills, Chester Co., June 26, 1910, *Bartram 1007* (ANSP, G); vicinity of Millersville, Lancaster Co., July 10, 1890, *Small* (NY, P).

Delaware: Centerville, 1866, *Commons* (MBG); same locality, June 24, 1879, *Commons* (US, G); Ellendale, July 23, 1878, *Canby* (US).

MARYLAND: Berwyn, June 5, 1912, *Greene* (MBG, US, ND); Deer Park, Aug. 4, 1906, *Carter* (ANSP); Hancock, June 11, 1927, *Woodson 1730* (MBG).

VIRGINIA: Dam Neck, Princess Anne Co., low ground, meadow, June 27, 1922, *Randolph & Randolph 481* (G); near Ocean View, Norfolk Co., July 8, 1898, *Kearney 1472* (US); Suffolk, Nansemond Co., June 8–13, 1893, *Heller 970* (US); Lacey Springs, June 12, 1927, *Woodson 1655* (MBG); Dumfries, June 13, 1927, *Woodson 1679* (MBG); roadside near Charlottesville, June 22, 1927, *Woodson 1746* (MBG); Buckroe, sandy meadow near seashore, May 18, 1912, *Robinson 362* (G); Glen Carlyn, June 25, 1905, *House 1060* (NY); Norfolk, May 25, 1922, *Meredith* (ANSP); Great Falls, dry field, Sept. 9, 1909, *Bartlett 1768* (P, D).

NORTH CAROLINA: moist grounds, [near Biltmore?], July 12, 1897, *Biltmore Herb. 79b* (MBG, US, NY).

SOUTH CAROLINA: Anderson, suburbs, damp banks, Aug. 15, 1919, *Davis 4984* (MBG); Anderson, dry soil, Aug. 15, 1919, *Davis 8426* (MBG).

GEORGIA: along railway, McDuffie Co., vicinity of Thomson, Aug. 5, 1909, *Bartlett 1690* (P).

FLORIDA: Jefferson Co., June–July, 1898, *Hitchcock* (MBG).

MISSISSIPPI: Ackerman, June, 1905, *Jensen 7* (MBG); Dlo, edge of pine forest, April 19, 1927, *Woodson & Anderson 1551* (MBG).

LOUISIANA: exact locality and date lacking, *Hale* (MBG).

OHIO: New Westerville, roadsides, June 10, 1927, *Woodson 1701* (MBG); Pittsfield, Lorain Co., date lacking, *Ricksecker* (US).

WEST VIRGINIA: near Wheeling, June 10, 1927, *Woodson 1676* (MBG); field, six miles north of Martinsburg, June 12, 1927, *Woodson 1682* (MBG); Harper's Ferry, banks of the Shenandoah, Oct. 21, 1913, *Greene* (ND).

MICHIGAN: edge of swampy ground on Belle Isle, July 16, 1892, *Farwell* (US); Flint, date lacking, *Canby 3422* (US).

INDIANA: Wells Co., Harrison Tp., on dry hills along Erie right-of-way, June 30, 1905, *Deam 11* (MBG, US); Steckland, 1889, *Evermann* (US); roadside along woods on the east side of Pitcher's Pond, about 5 mi. southwest of Mt. Vernon, Posey Co., June 14, 1918, *Deam 25405* (D); in woods, north boundary, State

Reservation, Clark Co., June 30, 1910, *Deam 6901* (D); bank of the White River, near Blue Bluffs, Morgan Co., July 13, 1907, *Deam 2276* (D); roadside bank 1 mi. east of Willow Valley, Martin Co., July 13, 1915, *Deam 17217* (D); in alluvial soil in the open woods in Jackson Park, about 1½ mi. west of Centerville, Wayne Co., July 3, 1913, *Deam 13562* (D); in a deep black and white oak woods 4 mi. southeast of Corydon, Harrison Co., June 27, 1916, *Deam 20524* (D).

KENTUCKY: Lexington, date lacking, *Griswold 1* (US).

ILLINOIS: Carbonate, 1878, *French* (US); dry prairie, Wabash Co., July 2, 1902, *Schenck* (US).

MINNESOTA: roadside, near Forest Lake, June 28, 1928, *Anderson & Woodson 5040* (MBG).

IOWA: exact locality lacking, Aug. 9, 1872, *Arthur* (MBG, US).

MISSOURI: Allenton, June 30, 1912, *Letterman* (MBG); Jerome, June 6, 1914, *Kellogg 470* (MBG); Jefferson Barracks, St. Louis Co., June 17, 1890, *Hitchcock* (MBG); rocky ledges, high hills, Galena, Stone Co., May 28, 1914, *E. J. Palmer 5792* (MBG); near summit, Pilot Knob, Iron Co., May 21, 1927, *Woodson 2703* (MBG); barrens, Wild Horse Creek Valley, St. Louis Co., June 16, 1918, *Hoffmann* (MBG).

TEXAS: in groups, margins of water-courses, Pierdenales and Three Creeks, June, 1847, *Lindheimer 659* (MBG); rocky creek-beds, Lindendale, Kendall Co., May 26, 1916, *E. J. Palmer 9893* (MBG); Purdy Creek, Gillespie Co., date lacking, *Jermy 196* (MBG).

NEW MEXICO: High Rolls, Otero Co., May 31, 1902, *Viereck* (ANSP).

6a. Apocynum cannabinum L. var. **pubescens** (Mitchell) A. DC. in DC. Prodr. **8**: 440. 1844; Bég. & Bel. R. Accad. Lincei, V. **9**: 103. 1913.

Apocynum cannabinum Michx. Fl. Bor.-Am. **1**: 121. 1803, *non* L.

Apocynum pubescens Mitchell *ex* R. Br. Mem. Wern. Soc. **1**: 63. 1809.

"*Apocynum pubescens* R. Br." *ex* Ell. Sketch Bot. S. C. & Ga. **1**: 315. 1821; Torr. Fl. N. & Mid. States, 276. 1824; G. Don,

Hist. Dichlam. Pl. **4**: 81. 1838; Darby, Bot. South. States, ed. 2. 434. 1860; Britt. & Brown, Ill. Fl. **3**: 23. 1913; Millsp. Fl. W. Va. 331. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. **21**: 230. 1919.

"*Apocynum cannabinum* L. var. *pubescens* (R. Br.) DC." *ex* A. Gray, Man. Bot. ed. 1, 364. 1848; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 662. 1908; Stone, Pl. South. N. J. 646. 1911; Wiegand & Eames, Fl. Cayuga, etc. 646. 1926.

Apocynum palustre Greene, Leafl. Bot. Obs. & Crit. **1**: 58. 1904.

Apocynum Bebbianum Greene, *l. c.* **2**: 168. 1912.

Apocynum dictyotum Greene, *l. c.* 169. 1912.

Apocynum cinereum Nieuwl. Am. Midl. Nat. **3**: 56. 1913.

Apocynum tomentellum Nieuwl. *l. c.* 55. 1913, *non* Greene.

Apocynum tomentulosum Nieuwl. *l. c.* 166. 1913.

Apocynum cannabinum L. var. *pubescens* (R. Br.) A. DC. forma *pennsylvanicum* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 103. 1913, *nomen.*

Apocynum cannabinum L. var. *palustre* (Greene) Bég. & Bel. *l. c.* 1913.

Stems tomentulose or glabrate; leaves tomentulose or pubescent upon either surface; inflorescence tomentose; in all other essential characters similar to the species.

Distribution: generally throughout the southeastern and central United States, also in north-central California; a frequent ballast weed. One collection has also been made in extreme southern Ontario.

Specimens examined:

Canada:

Ontario: Leamington, July 20, 1906, *Fisher* (D).

United States:

Massachusetts: Centreville, sandy copse, Scudder's Bay, July 5, 1896, *Williams* (G).

Rhode Island: Block Island, dry roadside banks and thickets, northeast of Great Salt Pond, Aug. 20, 1913, *Fernald, Hunnewell & Long 10241* (NE).

Connecticut: Southington, July 15, 1902, *Bissell* (NE); East Lyme, New London Co., June 26, 1903, *Graves* (NE); Fairfield, Sept. 26, 1895, *Eames* (NE); Southington, July 17, 1903, *Andrews* (ND).

New York: "western New York," exact locality and date lacking, *Torrey* (G, NY); moist field near Larch Meadows, Ithaca, Aug. 23, 1916, *Munz 601* (P); Junius, marly moor of Lowery's Pond, Aug. 4, 1919, *Eames & Wiegand 12761* (G); Ithaca, gravelly roadside, June 28, 1919, *Wiegand 12760* (G).

New Jersey: along railroad, Lakewood, Ocean Co., May 30, 1908, *Mackenzie 3093* (MBG, US); Mine Brook, July, 1891, *Perry* (MBG); Glassboro, July 4, 1865, *Redfield 4871* (MBG).

Pennsylvania: McCall's Ferry, July 2–6, 1904, *Britton* (NY); Brownsville, June 10, 1927, *Woodson 1656* (MBG); open places in the forest at Penryn, in old red sandstone, Aug. 7, 1926, *Heller 14239* (MBG).

Delaware: Wilmington, in woods, July 1, 1923, *Tidestrom 11516* (G, US); dry field near Georgetown, Sussex Co., July 5–6, 1908, *Britton 48* (NY, MBG).

Maryland: Silver Spring, Montgomery Co., June 28, 1899, *Miller* (US, P); Ocean City, July 12, 1909, *Carter* (NY); Kensington, June 11, 1905, *House 1007* (NY).

District of Columbia: B. & O. railroad embankment, July 17, 1893, *Boettcher 141* (G, MBG, US, NY); Woodridge, July, 1913, *Greene* (MBG, US).

Virginia: Suffolk, June, 1893, *Heller 464* (US); Chain Bridge, Fairfax Co., July 12, 1899, *W. Palmer 7* (G); Falls Church, July 30, 1874, *Carter* (ANSP); near Maurertown, June 12, 1927, *Woodson 1672* (MBG); Arlington Junction, Aug. 3, 1912, *Greene* (MBG, US); ten miles north of Amelia in moist soil along the highway in a wooded area, July 9, 1926, *Heller 13998* (MBG); exact locality lacking, 1865, *Glatfelter* (MBG).

North Carolina: coastal plain at White Lake, in sand, July 16, 1926, Bladen Co., *Heller 14103* (MBG); sand banks near Beaufort, 1906, *Lewis 220* (NY); Mt. Airy, June 19, 1909, *Rusby* (NY).

South Carolina: paper mill, Hartsville, May 22, 1909, *Coker* (NY); Santee Canal, May, year lacking, *Ravenel* (G); Abbeville, July, 1855, *Hexamer & Maier* (G).

Georgia: edge of pine barren, vicinity of Thomson, McDuffie Co., July 26, 1909, *Bartlett 1661* (P).

Alabama: Clanton, Apr. 21, 1927, *Woodson & Anderson 1608*

(MBG); Valley Head, July 18, 1898, *Ruth 463* (NY); Auburn, Apr. 25, 1898, *Earle 1644* (NY).

Mississippi: Ridgway, Apr. 18, 1927, *Woodson & Anderson 1541* (MBG); Jackson, Apr. 18, 1927, *Woodson & Anderson 1549* (MBG).

Ohio: exact locality and date lacking, *Throop Herb.* (P); Rocky River, near Cleveland, July 8, 1896, *Greenman 1438* (MBG); near Cincinnati, June 20, 1888, *Lloyd 296* (MBG).

Indiana: Bluffton, Sept. 1, 1904, *Deam & Gleason* (G); Notre Dame, along railroad, Oct. 8, 1913, *Nieuwland 11603* (MBG); Notre Dame, near ice house, June 23, 1913, *Nieuwland 11316* (MBG); in wooded lot across railway from Notre Dame University, June 29, 1928, *Nieuwland, Slavin & Woodson 3* (MBG); on rocky exposed hillside between Madison and North Madison, Jefferson Co., May 28, 1911, *Deam 8489* (D); in dry channel of creek near Langdon, Jackson Co., June 30, 1913, *Deam 13517* (D); along east side of Winona Lake, Kosciusko Co., July 28, 1904, *Deam* (D); on the bank of the Ohio River at Vevay, Switzerland Co., July 25, 1913, *Deam 13806* (D); low place near a wagon road in woods on the "knobs," 9 mi. north of Rockport, Spencer Co., June 9, 1918, *Deam 25230* (D); roadside about 5 mi. west of Danville, Hendricks Co., July 13, 1913, *Deam 13673* (D); sandy prairie roadside 1 mi. southwest of Bee Hunter, Greene Co., July 3, 1918, *Deam 25647* (D); dry open woods along Little Indian Creek, about 5 mi. northwest of New Albany, June 21, 1916, *Deam 20346* (D).

Kentucky: along roadsides, Lexington, July 20, 1923, *McFarland 131* (MBG); Iron Hill, Lyon Co., June 18, 1909, *Eggleston 4805* (NY).

Tennessee: Knoxville, June, 1897, *Ruth 3088* (NY); Obion Co., fields, in thin soil, June 28, 1893, *Bain 160* (G); Franklin Co., woods near Anderson, June 7, 1897, *Eggert* (MBG); open banks, low ground, near Memphis, Shelby Co., May 18, 1920, *E. J. Palmer 17528* (MBG).

Wisconsin: Racine Co., July, 1882, *Hasse* (NY); Preble, Brown Co., July 31, 1886, *Schuette* (NY).

Illinois: Winnebago Co., Fountaindale, date lacking, *Bebb* (ND, US); rock road near Fish Lake, July 16, 1898, *Norton*

(MBG); slough, near Columbia, Sept. 1, 1927, *Woodson 1926* (MBG); East St. Louis, June 19, 1879, *Eggert* (MBG); prairie, near Wady Petra, June 19, 1900, *V. H. Chase 631* (MBG, US); Odin, June 12, 1898, *Greene* (US).

Minnesota: cultivated fields north of Faribault, June 26, 1928, *Anderson & Woodson 5013* (MBG).

Iowa: Polk Co., July, 1847, *C. L. Parry* (NY).

Missouri: Courtney, dry ground, Aug. 2, 1906, *Bush 4083* (G, US, MBG); Swope Park, barrens, July 21, 1915, *Bush 7053* (G, MBG, US, NY); Webb City, prairies, June 23, 1911, *E. J. Palmer 3426* (G, MBG); Mansfield, frequent, open woods, etc., alt. 1480 ft., June 5–12, 1911, *Lansing 3171* (G, F); Sibley, dry ground, June 27, 1909, *Bush 5849* (G, MBG, NY); Courtney, common everywhere, July 17, 1899, *Bush 314* (G, MBG, NY, US); Jackson Co., July 16, 1893, *Bush 243* (G, MBG); Allenton, July 30, 1901, *Letterman* (MBG); near Cliff Cave, St. Louis Co., July 29, 1886, *Eggert* (MBG); Moscow Mills, July 23, 1927, *Woodson 1719* (MBG); Forest Mill, Jasper Co., June 23, 1909, *E. J. Palmer 2336* (MBG); near Webster Groves, railroad embankment, July 25, 1927, *Woodson 1729* (MBG); along Mo. Pac. Ry. 1. mi. s. of station, Webb City, June 23, 1911, *E. J. Palmer 3426* (MBG); dry open slope beside Ely Street, Hannibal, Marion Co., Aug. 21, 1914, *Davis 2947* (MBG); south of Oakwood, Ralls Co., July 16, 1915, *Davis 4762* (MBG); Turkey Creek, Jasper Co., July 10, 1897, *Trelease 709* (MBG); Shut-In, Arcadia, Iron Co., May 8, 1925, *Woodson 384* (MBG); Jefferson Barracks, St. Louis Co., June 17, 1890, *Hitchcock* (MBG); upland prairies near Asbury, Jasper Co., June 23, 1928, *E. J. Palmer 34676* (MBG).

Arkansas: low open ground, Corning, Clay Co., June 25, 1914, *E. J. Palmer 6092* (MBG).

North Dakota: Valley City, Aug. 6, 1917, *Mabbott 257* (NY).

Kansas: Riley Co., open ground, 1895, *Norton 324* (G, US, NY, MBG).

Oklahoma: Copan, Washington Co., in thickety field, Aug. 15, 1913, *Stevens 2105* (G); Sapulpa, common, July 30, 1894, *Bush 363* (MBG).

Texas: Farragut Co., June 2, 1913, *Ruth 387* (NY).

CALIFORNIA: Little Chico, June 1897, *Bruce 2093* (P); sloughs, Butte Co., May, 1898, *Bruce* (P); colonies in the marshes on drier spots, Suisun, Solano Co., June 6, 1903, *Baker 3247* (US, ND, MBG, P, G, NY).

Apocynum cannabinum L. var. *pubescens* is probably the most variable variety of the genus, and several foliage variations might be considered worthy of description in the absence of intergradations. Especially noteworthy in this instance is a race of obovate-leaved plants common in southern Missouri.

6b. Apocynum cannabinum L. var. **glaberrimum** A. DC. in DC. Prodr. **8**: 439. 1844; Rydb. Mem. N. Y. Bot. Gard. **1**: 311. 1900.

Apocynum canadense Shecut, Fl. Carol. **1**: 187. 1806.

Apocynum piscatorium Dougl. *ex* A. DC. *l. c.* 1844, *nomen in synon.*

Apocynum album Greene, Pittonia **3**: 230. 1897; G. S. Miller, Proc. Biol. Soc. Wash. **13**: 88. 1899; Millsp. Fl. W. Va. 331. 1913.

Apocynum nemorale G. S. Miller, Proc. Biol. Soc. Wash. **13**: 87. 1899; Bég. & Bel. R. Accad. Lincei, V. **9**: 110. 1913.

Apocynum cannabinum L. var. *nemorale* (G. S. Miller) Fernald, Rhodora **10**: 55. 1908.

Apocynum missouriense Greene, Leafl. Bot. Obs. & Crit. **2**: 165. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 109. 1913.

Apocynum isophyllum Greene, *l. c.* 166. 1912.

Apocynum littorale Greene, *l. c.* 171. 1912.

Apocynum arenarium Greene, *l. c.* 173. 1912; Bég. & Bel. *l. c.* 109. 1913.

Apocynum Bolandri Greene, *l. c.* 175. 1912.

Apocynum Carolini Nieuwl. Am. Midl. Nat. **3**: 53. 1913.

Apocynum pseudolaurinum Bég. & Bel. var. *latifolium* Bég. & Bel. *l. c.* 100. 1913, *nomen in synon.*

Apocynum cannabinum L. var. *album* (Greene) Bég. & Bel. *l. c.* 107. 1913.

Apocynum cannabinum L. var. *isophyllum* (Greene) Bég. & Bel. *l. c.* 1913.

Apocynum cannabinum L. var. *Bolandri* (Greene) Bég. & Bel. *l. c.* 108. 1913.

Apocynum cannabinum L. var, *floribundum* Bég. & Bel. *l. c.* 1913.

Apocynum nemorale G. S. Miller var. *glabrum* Bég. & Bel. *l. c.* 109. 1913.

Entire plant glabrous throughout; in all other essential characters similar to the species.

Distribution: probably common in every state in the United States, and sparingly in Canada; a common roadside and field weed.

Specimens examined:

Canada:

Quebec: St. Lambert, près du pont Victoria, vicinitè de Longueuil, Sept., 1919, *Victorin 9653* (G).

Ontario: Point Abino, Welland Co., Aug. 23, 1886, *Coville* (US).

Alberta: Calgary, July 16, 1913, *Moodie 116* (NY).

United States:

New Hampshire: Alstead, by Cold River, Aug. 2, 1900, *Fernald 375* (G).

Vermont: Salisbury, among thickets on the shore of Lake Dunmore, July 14, 1908, *Williams* (NE); wet banks, Queechee Gulf, July 4, 1910, *Britton* (NY); Leicester, damp ground, July 26, 1924, *Dutton* (MBG, G).

Massachusetts: Sharon, June, 1905, *Poole 36* (G); Huntington, rocky banks of small run, alt. 350 m., Aug. 17, 1912, *Robinson 563* (G); along brook in meadow, Granville, June 25, 1914, *Seymour 200* (MBG); stony shore, Stockbridge Brook, Berkshire Co., July 31, 1917, *Hoffman* (MBG).

Connecticut: Wethersfield, *Gray* (G).

New York: Ithaca, Triphammer Falls, gravelly shore, Fall Creek, July 17, 1913, *E. J. Palmer 965* (G); Savannah, Wayne Co., Crusoe Prairie, July 10, 1918, *Wright & Griscom 10620* (G); bed of Chenango River, June 25, 1882, *Lucy 5389* (MBG); marsh, Ithaca, July, 1878, *Trelease* (MBG); Fall Creek, June 26, 1889, *Norris* (MBG); Cayuga Flats, near Ithaca, July 15, 1893, *Schrenk* (MBG); East Greenwich, Long Island, 1867, *Fitch* (US); Chenango Forks, July, 1897, *Maxon* (US).

New Jersey: open woods, Cranberry Lake, Sussex Co., June 24, 1906, *Mackenzie 2125* (MBG, NY, D).

Pennsylvania: Inglesnook, Dauphin Co., July 16, 1912, *Williamson* (ANSP); rocks above Zimmerman's Ferry, Monroe Co., June 23, 1918, *Bartram* (G, ANSP); Susquehanna, July, 1889, *Eby* (MBG); Conewango Mts., Sept. 7, 1898, *Eisenhower* (MBG); gravel, Easton, July 13–Nov. 28, 1895, *Porter* (US).

Maryland: Great Falls, open ground along north side of canal, June 21, 1917, *Hitchcock 12909* (G, US); on sand-bar, Plum Point, Aug. 5, 1902, *Shull 173* (US, G, MBG, NY); on bar north of Swan Creek, July 26, 1902, *Shull 109* (MBG, US).

District of Columbia: at Chain Bridge, original station [of *A. album*], by canal, June 23, 1912, *Greene* (US, MBG, NY); exact locality and date lacking, *Canby* (US); flats near Chain Bridge, June 20, 1899, *Lyon* (US, P).

Virginia: Quinnimond, Aug. 25, 1899, *Pollard & Maxon* (US); Blue Ridge Mts. east of Waynesville, June 12, 1927, *Woodson 1698* (MBG).

Georgia: Wrightsboro, date lacking, *Chapman* (MBG); pine barrens, 1907, *Bartlett 1124* (P); sandy field, MacDuffie Co., Sept. 18, 1908, *Bartlett 1464* (P).

Florida: Mary Esther, Apr. 28, 1908, *Tracy 9449* (MBG, G, NY); old fields, Lake City, July 14, 1893, *Quaintance* (MBG); Aspalaga, 1898, *Chapman* (MBG); Apalachicola, date lacking, *Chapman* (NY).

Alabama: Jackson, Apr. 20, 1927, *Woodson & Anderson 1548* (MBG); along A. G. S. Railroad, Valley Head, July 18, 1898, *Ruth 481* (MBG, NY).

Louisiana: exact locality and date lacking, *Hale* (NY, G); borders of fields, near St. Martinsville, June 26, 1893, *Langlois* (ND).

Ohio: Garrettsville, July 25, 1901, *Webb* (G); Harmony, June 9, 1927, *Woodson 1650* (MBG).

West Virginia: pebbly shore of the Blackwater River, Hendricks, Tucker Co., Sept. 10, 1904, *Moore 2097* (G); Berea, dry soil, waste field, Aug. 21, 1922, *Randolph & Randolph 1356* (G).

Indiana: on border of swamp, Blackford Co., June 25, 1905, *Deam* (US); Roby, bog, Sept. 1, 1907, *Lansing 2679* (G, F); Spencer, moist sandy roadside, July 18, 1915, *Deam 17555* (G, MBG, D); wooded bank of Claypole Pond, Knox Co., July 8,

1915, *Deam 17004* (D); on the east bank of the north fork of the Muscatatack River, about 1 mi. north of Vernon, growing in rather open and rocky woods, July 9, 1911, *Deam 9135* (D); on a rocky ripple in Laugherty Creek back of Versailles, July 23, 1919, *Deam 13766* (D); on a stony bar of White Water River ¾ mi. northwest of Metamora. This bar overflows much of the wet season and plants are mostly decumbent, Sept. 12, 1924, *Deam 41020* (D); Dubois Co., on the border of the artificial lake about 1 mi. north of Jasper, July 2, 1912, *Deam 11566* (D).

KENTUCKY: Lexington, June, 1836, *Peter* (NY); North Bend, date lacking, *Short* (NY); Southern Hills, three miles south of Louisville, Aug. 15, 1892, *Bergmann* (MBG); Bowling Green, June 19, 1897, *Price* (MBG).

TENNESSEE: Robertson Co., woods near Greenbrier, July 13, 1897, *Eggert* (MBG).

WISCONSIN: near Portage, June 22, 1927, *Woodson 1660* (MBG); Milwaukee, Aug. 3, 1884, *Hasse* (NY).

ILLINOIS: St. Clair Co., French Village, Sept. 6, 1892, *Eggert* (MBG); Illinois State Park, Starved Rock, LaSalle Co., June–Sept., 1921, *Thone 33* (MBG); Olney, Richland Co., July 17, 1927, *Ridgway 2832* (MBG); near Falling Springs, St. Clair Co., Sept. 30, 1928, *Greenman 4594* (MBG); near 119th Street, West Pullman, Chicago, Aug. 8, 1907, *Greenman 1869* (MBG, F).

MINNESOTA: Hennepen Co., Aug. 1889, *Sandberg* (ND).

IOWA: fields and wastes, Decatur Co., Aug. 22, 1904, *J. P. Anderson* (MBG); exact locality lacking, July 20, 1875, *Arthur 23* (MBG).

MISSOURI: Webb City, rocky woods, Aug. 6, 1920, *Bush 9054* (NY, US, MBG); Carterville, July 13, 1920, *E. J. Palmer 18311* (NY, MBG); Cedar Gap, hillsides, alt. 1675 ft., May 22–June 2, 1911, *Lansing 2992* (G, F); Jackson Co., Aug. 8, 1883, *Bush* (MBG); Reeds, Jasper Co., June 28, 1913, *E. J. Palmer 4006* (MBG); St. Louis, July 3, 1895, *Glatfelter 338* (MBG); Creve Coeur Lake, July 4, 1906, *Johnson* (MBG); Silex, June 24, 1912, *Davis 1326* (MBG); St. Louis Co., in open woods, rather damp places, June, 1833, *Engelmann* (MBG); Joplin, July 4, 1902, common in woods, *E. J. Palmer 208* (MBG); Sarcoxie, rocky woods, Sept. 18, 1910, *E. J. Palmer 3188* (MBG); Mine La Motte,

Madison Co., June 22, 1897, *Monell* (MBG); Sheffield, common in fields, July 10, 1899, *Bush 159* (MBG); bottoms, Cass Co., June 14, 1865, *Broadhead* (MBG); common in open grounds, Clay Co., Randolph, July 17, 1898, *Mackenzie 253* (MBG); Allenton, June 8, 1896, *Kellogg* (MBG); near Gilmore, July 18, 1927, *Woodson 1747* (MBG); Frisco R. R. embankment, Webster Groves, July 22, 1927, *Woodson 1745* (MBG); Cliff Cave, St. Louis Co., May 9, 1879, *Eggert* (MBG); uncultivated field, near New London, Aug. 24, 1927, *Woodson 1748* (MBG); roadside south of Festus, May 31, 1926, *Woodson 681* (MBG).

Arkansas: Benton Co., date lacking, *Plank* (MBG); Benton, Saline Co., dry open ground, June 24, 1915, *E. J. Palmer 8133* (MBG).

North Dakota: Leeds, Aug. 21, 1907, *Lunell* (NY).

Nebraska: canyons, prairie & ruderal, Mitchell Co., Aug., 1899, *Hedgcock* (MBG); Republican Valley, alt. 2000 ft., May 21, 1894, *Laybourne 86* (MBG); Republican River, June 27, 1856, Lieut. Bryant's Expedition, *H. Engelmann* (MBG); Belmont, July 25, 1889, *Webber* (MBG); Wahoo, June, 1890, *Rydberg* (NY).

Kansas: Riley Co., wet places, Sept. 14, 1895, *Norton 324* (G, MBG, NY).

Oklahoma: vicinity of Fort Sill, June 17, 1916, *Clemens 11728* (MBG); Sapulpa, July 22, 1894, *Bush 359* (MBG); low grassy place, near Cleo, Major Co., June 8, 1913, *Stevens 798* (G, MBG).

Texas: moist river banks, Mertzon, Irion Co., July 4, 1917, *E. J. Palmer 12420* (MBG); Sherman, wet banks, June 23, 1872, *E. Hall 514* (G); locality lacking, 1835, *Drummond 232* (G); Fredericksburg, June, 1847, *Lindheimer 658* (G, MBG); Camp 36, Canadian, near sandhills, June, 1853, *Bigelow 691* (G); San Marcos, 1897, *Stanfield* (NY); Dallas, low rich lands, 1874, *Reverchon 599* (MBG); Coombs Ranch, Aug. 24, date lacking, *Reverchon* (MBG).

Montana: Box Elder Creek, Valley Co., July 14, 1900, *Blankinship* (MBG).

Wyoming: Hot Springs Bar, 20 mi. south of Jackson, July 19 1901, *Merrill & Wilcox 1042* (G).

Colorado: Montrose, July 17, 1897, *Shear 4808* (NY); Canyon City, 1872, *T. S. Brandegee 472* (MBG); Evans, 1909, *E. L. John-*

son 295 (MBG); Clear Creek Canyon, alt. 7000 ft., July 18, 1896, *Crandall* (MBG).

New Mexico: Pecos, San Miguel Co., alt. 6700 ft., Aug. 18, 1908, *Standley 5044* (G, US); exact locality lacking, 1847, *Fendler 692* (MBG).

Idaho: Priest Lake, Aug. 1901, *Piper 3702* (US, Epling Herb.); Clarke's Fork Valley, below Parma Mt., alt. 680 m., Aug. 21, 1895, *Leiberg 1557* (G, US, MBG); Twin Falls and Shoshone Falls, steep moist slope, alt. 3700 ft., July 26, 1911, *A. Nelson & Macbride 1361* (G, MBG, NY, F, W); open plains, Boise, alt. 2880 ft., July 13, 1911, *Clark 113* (G, MBG, NY, F).

Utah: Peterson Canyon, alt. 8000–10000 ft., July 19, 1902, *Pammel & Blackwood 4009* (G); Little Falls, July–Oct. 1879, *Ward* (US); St. George, alt. 2700 ft., Sept. 29, 1894, *M. E. Jones 6099* (US, MBG, P); Provo, gravel, alt. 4500 ft., June 25, 1894, *M. E. Jones 5490* (MBG, P).

Nevada: St. Thomas, May 25, 1919, *Tidestrom 9157* (US).

Arizona: White Mountains, Aug. 5–15, 1903, *Griffiths 5397* (US, MBG); Huachuca Mts., alt. 6000 ft., Sept. 3, 1903, *M. E. Jones* (P); Fort Whipple, river bottoms, Rio Verde, Sept. 9, 1865, *Coues & E. Palmer* (MBG); same locality, May, 1865, *Coues & E. Palmer 332* (MBG).

Washington: Lake Chelan, July 1, 1915, *Kammerer 71* (NY, MBG); meadows of the Okanogen River, Ophir, Okanogen Co., July, 1897, *Elmer 507* (MBG, W, US); foot of Priest Rapids, Yakima Co., July 17, 1903, *Cotton 1399* (MBG, W).

Oregon: dry sandy banks of Columbia River, Hood River Co., 1924, *Henderson 649* (MBG).

California: Santa Rosa, Sonoma Co., June 22, 1902, *Heller 5732* (G, NY, ANSP, MBG, F, D); along stream, Vallecillo Canyon, Laguna Mts., San Diego Co., alt. 3800 ft., June 26, 1924, *Munz 8417* (P); borders of swamps, alt. 300 m., San Bernardino Valley, June 21, 1907, *Parish 11427* (P); along the sycamore slough, Stinchfield Ranch, July 8, 1916, Colusa Co., *Stinchfield 373* (P); Cuyamosa Lake, June 26, 1903, San Diego Co., *Abrams 3913* (MBG); Hot Springs, July 24, 1875, *E. Palmer 220* (MBG).

6c. Apocynum cannabinum L. var. **Greeneanum** (Bég. & Bel.) Woodson, n. comb. Plate 17.

Apocynum Greeneanum Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 111. 1913.

Calyx-lobes equalling or slightly surpassing the corolla; corolla 3–4 mm. long; leaves glabrous above, pubescent beneath; in all other essential characters similar to the species.

Distribution: known only from the type locality in West Virginia.

Specimens examined:

West Virginia: Upshur Co., July 8, 1897, *Pollock* (MBG, US).

7. **Apocynum hypericifolium** Ait. Hort. Kew. ed. 1, **1**: 304. 1789; Pursh, Fl. Am. Sept. **1**: 179. ed. 1. 1814; Torr. Fl. N. & Mid. States, 276. 1824; G. Don, Hist. Dichlam. Pl. **4**: 81. 1838; Hook. Fl. Bor.-Am. **1**: 51. 1840; A. DC. in DC. Prodr. **8**: 440. 1844; Wood, Classb. Bot. ed. 29, 457. 1853; Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies **2**[2]: 193. 1911; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 112. 1913; Bergman, Fl. N. D. 229. 1918; Tidestrom, Contr. U. S. Nat. Herb. **25**: 419. 1925; Garrett, Spring Fl. Wasatch Region, 120. 1927. Plate 18.

Apocynum sibiricum Jacq. Hort. Vindob. **3**: 37. 1770; Britt. & Brown, Ill. Fl. **3**: 22. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. **21**: 230. 1919; Rydb. Fl. Rocky Mts. 669. 1917.

Apocynum purpureum Tausch, Flora **19**[2]: 385. 1836.

Apocynum cannabinum L. var. *hypericifolium* (Ait.) A. Gray, Man. Bot. ed. 1, 365. 1848; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 663. 1908; Wiegand & Eames, Fl. Cayuga, etc. 344. 1926.

Apocynum hypericifolium Ait. form. *arenarium* Gates, Torreya **11**: 128. 1911.

Apocynum estillinum Greene, Leafl. Bot. Obs. & Crit. **2**: 165. 1912.

Apocynum procerum Greene, *l. c.* 169. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 111. 1913.

Apocynum ithacense Greene, *l. c.* 170. 1912; Bég. & Bel. *l. c.* 110. 1913.

Apocynum subuligerum Greene, *l. c.* 171. 1912.

Apocynum cannabinum L. var. *estillinum* (Greene) Bég. & Bel. *l. c.* 107. 1913.

Apocynum neogeum Bég. & Bel. *l. c.* 108. 1913.

Apocynum hypericifolium Ait. var. *typicum* Bég. & Bel. *l. c.* 113. 1913.

Apocynum hypericifolium Ait. var. *intermedium* Bég. & Bel. *l. c.* 1913, *non* Bég. & Bel. *l. c.* 92. 1913, *nomen in synon.*

Apocynum lividum Greene var. *texanum* Bég. & Bel. *l. c.* 127. 1913.

Apocynum Farwellii Greene var. *glaucum* Farwell, Rept. Mich. Acad. Sci. **17**: 170. 1916.

Apocynum Farwellii Greene var. *glaucum* Farwell form. *ternarium* Farwell, *l. c.* 1916.

Apocynum Farwellii Greene var. *glaucum* Farwell form. *anomalum* Farwell, *l. c.* 1916.

Cynopaema hypericifolium (Ait.) Lunell, Am. Midl. Nat. **4**: 509. 1916.

Stems erect or somewhat ascending, 2–5 dm. tall, glabrous throughout, freely branched; branches opposite to sub-opposite, ascending; leaves opposite, nearly, or quite, sessile, and frequently subamplexicaul, especially below, mostly cordate or obtuse at the base, glabrous, or glaucous beneath, ovate to lanceolate, usually obtuse or rounded at the apex, or rarely subacute, membranaceous, entire, mucronate, or rarely without a mucro; inflorescence terminal, the bracts conspicuous, semifoliaceous; corolla sphaerico-cylindrical, about as long as broad, 2–3.5 mm. long, 2–3 mm. broad, the lobes erect; calyx-lobes lanceolate to ovate-oblong, 1.5–2 mm. long, entire, glabrous, scarious, follicles relatively short and straight, 4–10 cm. long, widely divergent, the seed 3.5–4 mm. long, the coma of the seed 8–12 mm. long.

Distribution: common in northeastern temperate North America, westward to Texas and the Dakotas, infrequent to the Pacific Coast, where it passes into var. *salignum*.

Specimens examined:

Newfoundland: Grand Falls, ledges and talus, north bank of Exploits River, below the Falls, July 22, 1911, *Fernald & Wiegand 6092* (G); Port à Port, gravelly banks of Romaine, July 30, 1921, *Mackenzie & Griscom 10413* (G).

Canada:

Nova Scotia: Sunny Brae, bar in river, July 29, 1913, *St. John 1439* (G); valley of the Barrasois River, Cape Breton Island,

July 25, 1914, *Nichols 345* (G); Five-mile River, Mant's Cove, July 19, 1920, *Pease & Long 22317* (G); Springville, Pictou Co., Aug. 25, 1906, *C. B. Robinson 502* (NY); between Windsor and Wolfville, June 26, 1863, *Howe* (NS); Pictou, Aug. 1873, *Lindsay* (NS).

New Brunswick: Ingelside, Westfield, Aug. 8, 1909, sandy riverbank, *Fernald 2074* (G); Woodstock, July 14, 1916, *Fernald & Long 14404* (G, ANSP); Keswick Ridge, Bass River, July 16, 1880, *Fowler* (MBG).

Quebec: Philipsburg, sandy shore of Lake Champlain, Aug. 10–11, 1923, *Knowlton* (G); Hatley, Lake Massawippi, July 21, 1923, *Knowlton* (G); Saint Andrè d'Argenteuil, July 28, 1925, *Adrien 21986* (G); Hull, July 5, 1922, *Victorin 15740* (G); Beauceville, July 13, 1922, *Fernald & Pease 25241* (G); vicinity of Montmorenci Falls, July 7, 1905, *Macoun 68532* (G, US); Pointe Bleu, shores of St. John, July 23, 1921, *Victorin 15742* (G); Matapedia, July 19, 1904, *Collins & Fernald* (G); Matane, Aug. 5, 1904, *Forbes* (G); Ste. Angele de Laval, July 31, 1923, *Chamberlain & Knowlton* (G); Compton, July 29, 1923, *Chamberlain & Knowlton* (G, US, MBG); sur les graviers calcaires de la Rivière Dartmouth, à 12 milles de l'embouchure, Gaspé, Juillet 27, 1923, *Victorin, Brunel, Rolland, Germain & Rousseau 17337* (G, MBG, D); Matapedia, July 19, 1904, *Collins & Fernald* (G); Dumois, July 25, 1921, *Victorin 15741* (G).

Ontario: vicinity of Ottawa, *Rolland 142* (G); Ottawa, Lac des Chenes, Sept. 1914, *Rolland & Germain* (G); border of bog, near Ipperwash, June 17, 1927, *Woodson 1686* (MBG); Grande Lake, Kingston Co., Oct. 17, 1879, *Fowler* (US).

Manitoba: Lake Winnipeg Valley, 1857, *Bourgeau* (G).

Saskatchewan: "south Saskatchewan," exact locality lacking, July 14, 1879, *Macoun 171* (US); locality lacking, 1857–58, *Bourgeau* (US).

Alberta: Milk River, July 19, 1895, *Macoun* (US); Crane Lake, July 3, 1894, *Macoun 5416* (G).

British Columbia: Columbia Valley, 1860, *Lyall* (G); lower Frazer River, 1859, *Lyall* (G); Home Lake, Vancouver Island, July 27, 1887, *Macoun* (NY); Chilliwack Valley, Aug. 21, 1901, *Macoun 54293* (US).

United States:

Maine: Rangeley Lakes, Middle Dam. Aug. 2, 1903, *B. L. Robinson* (G); East Livermore, sandy shore of Androscoggin River, June 23, 1908, *Parlin 2386* (G); St. Francis, July 30, 1900, *Williams* (G); Alegash River, Aroostook Co., July 28, 1900, *Williams* (G); Twin Brooks, July 28, 1900, *Williams* (G); Bethel, July 23, 1906, *Williams* (G); Sidney, open river-shores, Aug. 18, 1916, *Fernald & Long 14406* (G); Bar Island, St. Francis, July 14, 1903, *Pease 2267* (NE); Fort Fairfield, Aug. 10, 1909, *Fernald 2073* (G); Houlton, Aug. 12, 1909, *Fernald 2076* (NE); Orono, July 12, 1897, *Fernald* (NE); Eddington, Sept. 16, 1897, *Fernald* (NE); Moosehead Lake, Sept. 1891, *Furbish* (NE); vicinity of Skowhegan, June 30, 1903, *Chamberlain* (NE); Strong, Franklin Co., 1894, *Furbish* (NE); Farmington, Aug. 13, 1894, *Fernald* (NE); Vassalboro, July 6, 1916, *Fernald & Long 14402* (NE); Topsham, Sept. 1903, *Furbish* (NE); rocky river bottom, July 12, 1908, *Mackenzie 3468* (MBG).

New Hampshire: Milford, river bed, June 21–Aug. 7, 1899, *Wheeler* (G); Shelburne, date lacking, *Faxon* (G); East Andover, border of lake, Aug. 15, 1903, *Day* (G); Plainsfield, July 24, 1890 *collector lacking* (G); north of Androscoggin River, near Gorham line, Shelburne, June 26, 1908, *Pease 11332* (NE); Lake Ossipee, sandy beach, Aug. 10, 1921, *Pease 18104* (NE); Lake Wentworth, June, 1903, *Fuller* (NE); Hillsborough, open ground, July 28, 1920, *Batchelder* (NE); Langdon, gravelly margin of Cold River, July 10, 1899, *Fernald 37* (NE); Walpole, June 12, 1912, *Batchelder* (NE).

Vermont: Brattleboro, river-bank, Aug. 2, 1898, *B. L. Robinson 135* (G); Brookline, West River, Aug. 4, 1900, *Eggleston & Grout 2060* (G); Peacham, date lacking, *Blanchard* (MBG); Gardiner's Island, Ferrisburg, July 17, 1909, *Eggleston 4872* (MBG); Salisbury, Lake Dunmore, July 14, 1908, *Williams* (NE); Knight's Island, Lake Champlain, July 23, 1882, *Brainerd* (NE); Wallingford, Mill River, July 14, 1909, *Kent* (NE); Lake Champlain, July 2, 1902, *Fuller* (NE); Townshend, Aug. 12, 1915, *Wheeler* (NE).

Massachusetts: Granville, along brook in meadow, June 25, 1914, *Seymour 200* (G, MBG); Willoughby Lake, July 3, 1854, *Boott* (G); Sharon, Lake Massapoag, Sept. 10, 1899, *Williams* (G); Lawrence, July 9, 1902, *Pease 1089* (NE); Lynn, sluice pond,

July 5, 1880, *Young* (NE); Lancaster, near Sterling, July 6, 1913, *Forbes* (NE); South Deerfield, June 26, 1925, *Churchill* (NE); Springfield, July 13, 1914, *Andrews* (NE); Stockbridge, July 13, 1914, *Andrews* (NE); Cheshire, Sept. 5, 1915, *Knowlton* (NE).

Rhode Island: Ouanochoutaug, Washington Co., July 24, 1920, *Hope* (NE).

Connecticut: Lyme, alluvial soil, Aug. 29, 1901, *Bissell* (G); East Hartford, July 21, 1911, *Driggs* (NE); Windsor, June 6, 1903, *Driggs 2326* (NE).

New York: Butler, Westburg Bog, July 3, 1919, *A. H. Wright 12759* (G); Canton, Aug. 4, 1916, *Phelps 1690* (G); Junius, moor of Newton's Pond, date lacking, *Wiegand 3038* (G); Ithaca, Six-Mile Creek, Oct. 11, 1913, *Eames & McDaniels 964* (G); Morristown, shore of Black Lake, June 21, 1914, *Phelps 783* (G); Oneida Lake, Vienna Beach, June 21, 1903, *Haberer 2202* (G, NY); Oneida Co., Sylvan Beach, Aug. 24, 1906, *House 2822* (G, NY); Norwich Creek, Aug. 7, 1888, *Fitch* (P); Oxford River, Chenango Co., June 28, 1884, *A. L. Coville* (P); near Syracuse, *Underwood* (US); Penn Yann, Yates Co., date lacking, *A. H. Wright* (US); Schroon Lake, Essex Co., Aug. 16, 1887, *Heller* (ANSP); Ithaca, June 27, 1885, *F. V. Coville* (US).

Pennsylvania: Wrightsville, June 7, 1890, *Small* (NY); about the mouth of the Tucquan, Lancaster Co., Oct. 20, 1901, *Heller* (US); Frazer, Chester Co., dry shale bank, June 19, 1910, *Bartram* (G, ANSP); mouth of Tucquan, Lancaster Co., July 6, 1893, *Heller & Halbach 1039* (G, MBG, US); open places in the forest at Penryn in old red sandstone, Lebanon Co., Aug. 7, 1926, *Heller 14240*, in part. (MBG).

New Jersey: Sussex Co., June 9, 1918, *Bartram* (ANSP); Phillipsburg, Aug. 15, 1890, *Porter* (NY); Newton, Apr. 19, 1907, *Carter* (ANSP).

Delaware: New Castle, July 11, 1894, *Tatnall* (G); Seaford, Sept. 12, 1902, *Norton* (MBG).

District of Columbia: hard sterile clay, near 15th & H Sts. Washington, Aug. 7, 1912, *Greene* (MBG, US).

Ohio: Berea, June, 1896, *Ashecroft* (G); Berlin, June, 1896, *Hicks* (MBG); Erie Co., on sand dunes on Cedar Point opposite Sandusky, July 12, 1903, *Deam* (D).

West Virginia: White Sulphur, Aug. 12, 1922, *Randolph & Randolph 1240* (G); Piedmont, Sept. 20, 1881, *Donnell-Smith* (G, US).

Michigan: Hubbardstown, 1877, *E. F. Smith* (G).

Indiana: Notre Dame, Oct. 3, 1912, *Nieuwland 10379* (ND, MBG); Roby, damp thicket, July 12, 1906, *Lansing 2543* (G, F, US); Miller's, July 7, 1908, *Lansing 2769* (G); Crothersville, June 30, 1913, *Deam 13500* (MBG, G); Jackson Co., along the railroad ¼ mi. south of Chestnut Ridge, June 7, 1913, *Deam 13280* (D); Knox Co., bank of the Wabash River, 2 mi. northeast of Mt. Carmel, Illinois, growing in thin soil on the sandstone rock, September 21, 1920, *Deam 32972* (D); in rock ballast along the traction line, 2 mi. north of Scottsburg, Scott Co., July 27, 1920, *Deam 31973* (D); along railroad near Sandy Hook Switch, about 6½ mi. southwest of Washington, Daviess Co., July 2, 1918, *Deam 25609* (D); in the bottom of an old gravel pit along the Penna. Ry., about 3 mi. north of Columbus, Bartholomew Co., Sept. 15, 1912, *Deam 12405* (D).

Wisconsin: Milwaukee, date lacking, *Lapham* (G); Brown Co., July 9, 1881, *Schuette* (G, US); Preble, Brown Co., July 31, 1886, *Schuette* (US).

Illinois: Champaign, June 27, 1899, *Gleason 687* (G); Stony Island, Cook Co., Sept. 10, 1893, *H. H. Smith 5935* (G); near East Carondelet, St. Clair Co., July 18, 1893, *Eggert* (MBG); Cahokia, July 31, 1890, *Hitchcock* (MBG).

Minnesota: Brainerd, Aug. 10, 1903, *Mell & Knopf* (MBG); *Clitherall* (US).

Iowa: exact locality lacking, 1886, *Norris* (MBG); exact locality lacking, July 15, 1875, *Arthur* (MBG).

Missouri: banks of the Mississippi, below St. Louis, Aug., 1863, *Engelmann* (MBG); Courtney, June 27, 1900, *Bush 809* (MBG); open dry bank, Dodson, June 9, 1917, *Hoffman* (MBG).

North Dakota: borders of Lake Ibsen, Sept. 3, 1899, *Lunell* (G, NY); Leeds, Aug. 2, 1899, *Lunell* (G, ND, NY); plains, exact locality and date lacking, *Hooker* (G); in low open area about lake, Fort Totten, July 2, 1912, *Bergman 1932* (MBG).

South Dakota: White Rock, 1903, *Powell* (G); Deadwood, elev. 4500 ft., Aug. 26, 1910, *Murdock 4330* (G); Brookings, 1903, *Johnson* (MBG).

NEBRASKA: Red Cloud, July 5, 1907, *Bates* (G); Norway, Middle Loup district, on hills, June 22, 1893, *Rydberg 1353* (NY, G, US); Fort Kearney, July 1–13, 1849, *Gunison* (G); Cheyenne Co., alt. 3700 ft., Aug. 6, 1901, *H. P. Baker* (MBG); Oasis, sand-hills of western Nebraska, July 13, 1912, *Poole & Folsom* (MBG); Middle Gulch, Scotts Bluff Co., Aug. 13, year and collector lacking (MBG); roadsides, near western outskirts of McCook, Red Willow Co., July 11, 1929, *Woodson 29162* (MBG); dry fields, west of Friend, Saline Co., June 14, 1929, *Woodson & Anderson 28988* (MBG).

KANSAS: Osborne City, hills, June 5, 1894, *Shear 88* (G); Garden City, June 17, 1891, *Menke* (MBG).

OKLAHOMA: Canadian River, Norman, Oct. 3, 1914, *Emig 878* (MBG); Woodward Co., prairies near Woodward, June 6, 1901, *Eggert* (MBG).

TEXAS: Pierdenales, June, 1847, *Lindheimer 659*, in part (G, MBG); Estelline, sands, May 25, 1904, *Reverchon 4309* (US, MBG, G, F, P); Post, Garza Co., May 31, 1918, *E. J. Palmer 13849* (MBG); in watered canyons, Gamble's Ranch, Armstrong Co., June 5, 1918, *E. J. Palmer 13926* (MBG); Turtle Creek, Kerr Co., May 2, 1899, *Bray 216* (US); moist open ground along small creek, 15 miles south of Alpine, Brewster Co., May 28, 1928, *E. J. Palmer 34233* (MBG).

WYOMING: C. Y. Ranch, July 23, 1894, *A. Nelson 596* (MBG, NY, F, G).

Jacquin published *A. sibiricum* nineteen years previous to the publication of *A. hypericifolium* Ait. Moreover, the description of the former was accompanied by a full-page folio illustration of the habit of the plant. The Latin description of the former, also, was far more elucidating than the unillustrated and terse description of Aiton. However, as can be quickly perceived by a glance at the citations in literature on page 133, botanists were quick to take up *A. hypericifolium* Ait., while *A. sibiricum* Jacq., perhaps because of the misleading geographical adjective, was disregarded for over a hundred years after its publication. In such a case, the practical course is to follow the so-called "Fifty year rule" tacitly established in the International Code of Nomenclature, and adopt the better-known designation.

7a. Apocynum hypericifolium Ait. var. **Farwellii** (Greene) Woodson, n. comb.

Apocynum Farwellii Greene, Leafl. Bot. Obs. & Crit. **2**: 168. 1912.

Apocynum Farwellii Greene form. *verticillare* Farwell, Rept. Mich. Acad. Sci. **17**: 170. 1916.

Plant variously pubescent; in all other essential characters similar to the species.

Distribution: central New York, eastern Michigan, and northern Indiana; apparently also collected in Texas.

Specimens examined:

New York: thickets near Oneida Castle, Oneida Co., June 17, 1921, *House 8100* (G, NY).

Michigan: Huron Co., Saginaw Bay, in wet places, Aug. 24, 1908, *Farwell* (US, G); Detroit, July 7, 1898, *Farwell* (US, ND).

Indiana: Bluffton, margin of a peat-bog lake, Sept. 1, 1904, *Deam & Gleason* (G, NY); Steuben Co., on east shore of Clear Lake, September 11, 1904, *Deam* (D); Noble Co., in low place near Rome City, July 21, 1904, *Deam* (D); in wood about ⅛ mi. south of Hartford, Blackford Co., July 8, 1906, *Deam 1168* (D).

Texas: exact locality lacking, 1847, *Lindheimer 659*, in part (MBG).

Upon one of his collecting trips in southern Ontario, the author happened upon a most peculiar plant growing near the margin of a bog at Ipperwash, on the shore of Lake Huron (*Woodson 1686*, Mo. Bot. Gard. Herb.). Several of the stems arising from the common rhizome bore ordinary opposite leaves, obtuse at the apex; while one stem alone bore leaves decidedly acute at the apex in clusters of three throughout the length of the stem. Such an anomaly might be assigned to a chimera or to the action of certain gall-producing flies or other insects, although no mark of them is evident upon the specimen. Such a phenomenon has also been observed by Mr. O. A. Farwell in the neighboring state of Michigan, and the plants have been designated as *A. Farwellii* Greene form. *verticillare* Farwell, *A. Farwellii* Greene var. *glaucum* Farwell form. *ternarium* Farwell, and *A. Farwellii* Greene var. *glaucum* Farwell form. *anomalum*. However, in the light of the author's personal experience with such vegetative freaks, all such

phenomena in the case of the genus *Apocynum* are judged unworthy of nomenclatoral designation.

Because of its geographical distribution, as well as for the reason of vegetative variability, *A. hypericifolium* var. *Farwellii* is regarded as a probable spontaneous variation analogous to *A. medium* var. *sarniense.*

7b. Apocynum hypericifolium Ait. var. **cordigerum** (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 114. 1913.

Apocynum cordigerum Greene, Leafl. Bot. Obs. & Crit. **2**: 164. 1911.

Leaves ovate to obovate, deeply cordate to amplexicaul, at least below; in all other essential characters similar to the species.

Distribution: upper Mississippi Valley, from the Dakotas, Minnesota, and Wisconsin, to Missouri and Illinois.

Specimens examined:

WISCONSIN: Hillside, near Mazomanie, June 22, 1927, *Woodson 1740* (MBG); south of La Crosse, fields, June 25, 1928, *Anderson & Woodson 5005* (MBG).

ILLINOIS: Red Bud, June 3, 1888, *Pammel* (MBG).

MINNESOTA: locality lacking, July, 1849, *Sykes* (MBG).

MISSOURI: four miles east of Blue Springs in an uncultivated field, July 3, 1926, *Heller 13988* (MBG); Ethel, June 12, 1915, *Bush 7611* (MBG).

NORTH DAKOTA: Grand Forks, prairies, July 20, 1895, *Brannon* (MBG); Butte, Benson Co., July 14, 1907, *Lunell* (D); in gravel on the beach, Devil's Lake, Ramsey Co., Aug. 18, 1910, *Lunell* (D).

SOUTH DAKOTA: Brookings, *T. A. Williams* (US).

NEBRASKA: bottoms of Platte River, July 9, year lacking, *H. Engelmann* (MBG).

7c. Apocynum hypericifolium Ait. var. **salignum** (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 115. 1918. Plate 19.

Apocynum salignum Greene, Pittonia **5**: 64. 1902.

Apocynum nevadense Good. Bot. Gaz. **37**: 57. 1904.

Apocynum cervinum Greene, Leafl. Bot. Obs. & Crit. **2**: 174. 1912.

Apocynum Breweri Greene, *l. c.* 176. 1912.

Apocynum densiflorum Greene, *l. c.* 1912.

Apocynum thermale Greene, *l. c.* 1912.

Apocynum longifolium Greene, *l. c.* 177. 1912.

Apocynum hypericifolium Ait. var. *latifolium* Bég. & Bel. *l. c.* 115. 1913, *nomen in synon.*

Apocynum cuspidatum Greene *ex* Bég. & Bel. *l. c.* 1913, *nomen in synon.*

Apocynum Macounii Greene *ex* Bég. & Bel. *l. c.* 1913, *nomen in synon.*

Apocynum hypericifolium Ait. var. *nevadense* (Good.) Bég. & Bel. *l. c.* 1913.

Apocynum hypericifolium Ait. var. *oblongum* (Greene) Bég. & Bel. *l. c.* 1913.

Apocynum pseudolaurinum Bég. & Bel. var. *dubium* Bég. & Bel. *l. c.* 1913, *nomen in synon.*

Corolla tubulo-cylindrical, longer than broad; coma of the seeds 15–20 mm. long; in all other essential characters similar to the species.

Distribution: Pacific Coast to the Rocky Mountains; infrequent eastward to central Minnesota and Texas.

Specimens examined:

Canada:

Manitoba: Brandon, July 24, 1896, *Macoun 14156* (G).

Saskatchewan: Saskatoon, July 27, 1906, *Macoun & Herriot 78489* (G, US).

British Columbia: Penicton, 1903, *Newcombe 293* (F); near international boundary, between Kettle and Columbia Rivers, June 30, 1902, *Macoun 66554* (US, ND).

United States:

Minnesota: near Northbranch, Chisago Co., June 26, 1928, *Woodson & Anderson 5025* (MBG).

South Dakota: Brookings, Aug. 1894, *Thornber* (MBG).

Nebraska: Nuckolls Co., prairies and canyons, July, 1899, *Hedgcock* (MBG).

Texas: Limpia Canyon, Apr. 26, 1902, *Tracy & Earle 286* (MBG, G, US).

Montana: Sixteen-Mile Creek, alt. 4500 ft., July 10, 1863,

Scribner 151 (G, ANSP, US); Yellow Bay, Flathead Lake, Aug. 11, 1908, *M. E. Jones 8878* (P).

Wyoming: Platte River, near Ferris, July 19, 1898, *E. Nelson 4901* (P); on Gardner River, among shrub-like plants, July 19, 1899, *Nelson & Nelson 6923* (P).

Colorado: Paradox, Monroe Co., creek bottoms, June 28, 1912, *Walker 191* (G, MBG, NY, US); Naturita, river bottoms, alt. 5400 ft., June 24, 1913, *Payson 116* (G, MBG); Deer Run, alt. 4700 ft., June 11, 1901, *Baker 80* (G, ND, US, P, MBG, W); damp ground, Greeley, July 22, 1907, *E. L. Johnson 246* (MBG); Fort Collins, alt. 5000 ft., June 30, 1894, *Baker* (P); fields, south of Castle Rock, Douglas Co., June 24, 1929, *Woodson & Anderson 29100* (MBG); south of Lyons, Boulder Co., June 23, 1929, *Woodson & Anderson 29109* (MBG); roadside near mouth of North St. Vrain Canyon, west of Lyons, Boulder Co., July 25, 1929, *Woodson & Barnhart 29029* (MBG).

New Mexico: Roswell, moist ground, May 26, 1916, *Peacock 56* (F); Las Vegas, July, 1881, *Vasey* (ND); Gilmore's Ranch, Otero Co., July 14, 1895, *Wooton* (US, P); headwaters of Cimarron River, June 13, 1846, *Wislizenus 458* (MBG); Mesilla Valley, Dona Ana Co., Apr. 29, 1906, *Standley 14* (US, MBG); Cimarron Canyon, June 30, 1929, *Mathias 558* (MBG).

Idaho: Boise, loamy slope, alt. 2880 ft., June 17, 1910, *Macbride 247* (G, MBG, W); shores, south end of Lake Pend d'Oreille, Aug. 4, 1892, *Sandberg, MacDougal & Heller 825* (G, US); rocky hillsides, Three Creek, Idaho Co., May 18, 1926, *Ransom & Ridout 146* (W).

Utah: Murray, Salt Lake Co., July 18, 1917, *M. E. Jones* (P, G); Red Butte, July 11, 1908, *Clemens* (ANSP); Peterson Canyon, Peterson, alt. 8000–10000 ft., July 19, 1902, *Pammel & Blackwood 4009* (MBG); Provo, alt. 4500 ft., June 25, 1894, *M. E. Jones 5490* (P, MBG).

Nevada: Caliente, moist sides of a canyon, May 29, 1902, *Goodding 986* (G, P, MBG, US, NY); Beattie, elev. 3500 ft., June 5, 1912, *Heller 10417* (MBG); Reno, alt. 4500 ft., June 11, 1897, *M. E. Jones* (P); Palisade, June 14, 1882, *M. E. Jones* (P); Pallon. along ditches, July 31, 1919, *Tidestrom 10791* (F).

Arizona: Clemenceau, May 22, 1922, *W. W. Jones 79* (G).

Oregon: Clearwater, date lacking, *Spaulding* (G, MBG).

California: Mt. Tejon and vicinity, 1857–58, *Vesey 100* (NY); Yosemite Valley, June 19, 1863, *Brewer 1673* (US); Humboldt Co., date lacking, *Chestnut & Drew* (ND); Glenn Co., July 7, 1914, *Heller 11532* (G, MBG); Sespe Creek, Ventura Co., alt. 2300–2500 ft., June 9, 1908, *Abrams & MacGregor 184* (G, MBG, US, NY); Los Gatos, foothills, Santa Clara Co., June 16, 1904, *Heller 7518* (G, MBG, NY, D, ANSP, F); Cuyamaca Lake, San Diego Co., June 26, 1903, *Abrams 3913* (NY, G, MBG); Grass Valley, Nevada Co., July 14, 1905, *Heller 8109* (G, NY, ANSP, F, MBG); Table Mountain, Olive Ranch, north of Oroville, Butte Co., June 4, 1913, *Heller 10779* (G, NY, ANSP, US, F, MBG); "Indian Rock," Fern Valley, San Jacinto Mts., alt. 6000 ft., July 18, 1923, *Spencer 2360* (G); Cold Water Canyon, San Antonio Mts., San Bernardino Mts., July 12, 1902, *Abrams 2709* (G, NY, ANSP, MBG); Mud Flat, on the Newville-Covelo road, July 7, 1914, *Heller 11532* (MBG, NY, ANSP, F, US); Tessajara Hot Springs, Monterey Co., June, 1901, *Elmer 3180* (MBG, US); Lytle Creek, San Bernardino Co., alt. 7000 ft., July 24, 1901, *Abrams 1941* (P); near springy place near Palomar Hotel, Palomar Mt., San Diego Co., alt. 5000 ft., June 23, 1924, *Munz 8324* (P); Twenty-nine Palms, wet meadow, alt. 3000 ft., May 1, 1921, *Munz 4517* (P).

EXCLUDED SPECIES

Apocynum Acouci Aubl. Pl. Guian. **1**: 274. 1775 = **Forsteronia Acouci** (Aubl.) A. DC. in DC. Prodr. **8**: 439. 1844.

Apocynum africanum Lour. Fl. Cochinch. **1**: 168. 1790 = **Ichnocarpus africanus** (Lour.) Woodson, n. comb. (*Ichnocarpus Loureiri* Spreng. Syst. **1**: 635. 1825).

Apocynum agglomeratum Poir. Encycl. **1**: 407. 1810 = **Marsdenia Clausa** R. Br. Mem. Wern. Soc. **1**: 30. 1809.

Apocynum alterniflorum Lour. Fl. Cochinch. **1**: 168. 1790 = **Gymnema sylvestris** (Willd.) R. Br. Mem. Wern. Soc. **1**: 33. 1809.

Apocynum androsaemifolium Forsk. Fl. Aeg.-Arab. 22. 1775, *non* L. = **Trachomitum venetum** (L.) Woodson, Ann. Mo. Bot. Gard. **17**: 158. 1930.

Apocynum angustifolium Sesse & Mociño, Pl. Nov. Hisp. ed. 2, 40. 1893 = **Funastrum bicolor** (Decne.) Macbr. Contr. Gray Herb. N. S. **49**: 50. 1917.

Apocynum apiculatum Lam. Encycl. **1**: 214. 1783 = **Forsteronia Acouci** (Aubl.) A. DC. in DC. Prodr. **8**: 439. 1844.

Apocynum bursiflorum Noronha, Verh. Batav. Gen. ed. 1, **5**: 5. 1790 = **Strophanthus** sp.?

Apocynum canariense Lam. Encycl. **1**: 212. 1783 = **Gomphocarpus** sp.?

Apocynum citrifolium Descourt. Fl. Med. Antill. **3**: 180. *t. 191.* 1827 = **Marsdenia fusca** Wright *ex* Griseb. Cat. Pl. Cub. 178. 1866 (?).

Apocynum compressum Moench, Meth. 464. 1794 = **Trachomitum venetum** (L.) Woodson, Ann. Mo. Bot. Gard. **17**: 158. 1930.

Apocynum cordatum Mill. Gard. Dict. ed. 8. 1768, *non* Thunb. = **Rhabdadenia cordata** (Mill.) Miers, Apoc. S. Am. 122. 1878.

Apocynum cordatum Thunb. Prodr. Pl. Cap. 47. 1775, *non* Mill. = **Astephanus cordatus** (Thunb.) R. Br. Mem. Wern. Soc. **1**: 54. 1809.

Apocynum cordifolium Sesse & Mociño, Pl. Nov. Hisp. ed. 2, 39. 1893, *non* Tenore = **Prestonia** sp.?

Apocynum cordifolium Tenore, *ex* Steud. Nom. Bot. ed. 2, **1**: 113. 1841, *non* Sesse & Mociño = **Astephanus cordatus** (Mill.) R. Br. Mem. Wern. Soc. **1**: 54. 1809.

Apocynum cotinifolium Tenore, *ex* Steud. Nom. Bot. ed. 2, **1**: 113. 1841 = **Ichnocarpus** sp.?

Apocynum crassifolium Salisb. Prodr. 149. 1796 = **Ichnocarpus frutescens** (L.) R. Br. Mem. Wern. Soc. **1**: 62. 1809.

Apocynum cumanense Willd. *ex* Roem. & Schult. Syst. **6**: 796. 1820 = **Metaplexis fimbriata** (Kunth) Spreng. Syst. **1**: 854. 1825.

Apocynum erectum Vell. Fl. Flum. **3**: 123. *t. 87.* 1827 = **Barjonia erecta** (Vell.) K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4²**: 285. 1895.

Apocynum filiforme Thunb. Prodr. Pl. Cap. 47. 1775 = **Eustegia filiformis** (Thunb.) Roem. & Schult. Syst. **6**: 120. 1820.

Apocynum fimbriatum Sesse & Mociño, Fl. Mex. 78. 1894 = **Prestonia contorta** (Mart. & Gal.) Hemsl. Biol. Centr.-Am. Bot. **2**: 311. 1881.

Apocynum floristratum Noronha, Verh. Batav. Gen. **5**: 5. 1790 = **Strophanthus** sp.?

Apocynum foetidum Burm. Fl. Ind. 71. 1768 = **Paederia foetida** L. Mant. **1**: 52. 1767.

Apocynum fructu spinoso Descourt. Fl. Med. Antill. **3**: 171. 1827 = **Ibatia maritima** (Jacq.) Decne. in DC. Prodr. **8**: 599. 1844.

Apocynum frutescens Afzel. Remed. Guin. Coll. **4**: 28. 1813, *non* L. = **Ichnocarpus Afzelii** Roem. & Schult. Syst. **4**: 399. 1819.

Apocynum frutescens L. Sp. Pl. ed. 1, 213. 1753, *non* Afzel. = **Ichnocarpus frutescens** (L.) R. Br. Mem. Wern. Soc. **1**: 62. 1809.

Apocynum grandiflorum Danguy in Lecomte, Not. Syst. **2**: 137. 1911 = **Poacynum grandiflorum** Danguy in Lecomte, *l. c.* 1911.

Apocynum hastatum Thunb. Prodr. Pl. Cap. 47. 1775 = **Eustegia hastata** (Thunb.) R. Br. Mem. Wern. Soc. **1**: 51. 1809.

Apocynum Hendersonii Hook. f. in Hume & Henders. Lahore to Yarkand, 327. 1873 = **Poacynum Hendersonii** (Hook. f.) Woodson, Ann. Mo. Bot. Gard. **17**: 167. 1930.

Apocynum imbricatum Sesse & Mociño, Fl. Mex. 77. 1894 = **Funastrum bicolor** (Decne.) Macbr. Contr. Gray Herb. N. S. **49**: 50. 1917. (?)

Apocynum indicum Lam. Encycl. **1**: 214. 1783 = **Eustegia hastata** (Thunb.) R. Br. Mem. Wern. Soc. **1**: 51. 1809.

Apocynum Juventas Lour. Fl. Cochinch. 167. 1790 = **Tylophora Juventas** (Lour.) Woodson, n. comb. (*Tylophora ovata* Hook. *ex* Steud. Nom. Bot. ed. 2, **2**: 726. 1841.

Apocynum lanceolatum Thunb. Prodr. Pl. Cap. 47. 1775 = **Astephanus lanceolatus** (Thunb.) R. Br. Mem. Wern. Soc. **1**: 54. 1809.

Apocynum lineare L. f. Suppl. **1**: 169. 1781 = **Astephanus linearis** (L. f.) R. Br. Mem. Wern. Soc. **1**: 54. 1809.

Apocynum maculatum Descourt. Fl. Med. Antill. **3**: 176. *t. 190.* 1827 = **Marsdenia Clausa** R. Br. Mem. Wern. Soc. **1**: 30. 1809.

Apocynum mexicanum Sesse & Mociño, Pl. Nov. Hisp. ed. 2, 39. 1893 = **Funastrum bicolor** (Decne.) Macbr. Contr. Gray Herb. N. S. **49**: 50. 1917.

Apocynum minutum L. f. Suppl. **1**: 169. 1781 = **Eustegia hastata** (Thunb.) R. Br. Mem. Wern. Soc. **1**: 51. 1809.

Apocynum mucronatum Blanco, Fl. Filip. ed. 1, 852. 1827 = **Toxocarpus mucronatus** (Blanco) Woodson, n. comb. (*Toxocarpus gracilis* Decne. in DC. Prodr. **8**: 505. 1844).

Apocynum Nerium Aubl. Pl. Guian. **1**: 277. 1775 = **Anechites Nerium** (Aubl.) Urb. in Fedde, Repert. Sp. Nov. **16**: 150. 1919.

Apocynum nervosum Mill. Gard. Dict. ed. 8. 1768 = **Rhabdadenia nervosa** (Mill.) Miers, Apoc. S. Am. 122. 1878.

Apocynum obliquum Mill. *l. c.* 1768 = **Echites umbellata** Jacq. Enum. Pl. Carib. 13. 1760.

Apocynum odoratissimum Lour. *ex* Pritz. Icon. Ind. 83. 1865 = **Telosma odoratissima** (Lour.) Coville, Contr. U. S. Nat. Herb. **9**: 384. 1905.

Apocynum orixense Rottl. *ex* Hook. f. Fl. Brit. Ind. **4**: 6. 1885, *nomen.* = **Cryptolepis elegans** Wall. *ex* Hook. f. *l. c.* 1885.

Apocynum paniculatum Lam. Encycl. **1**: 214. 1783, *non* Greene = **Forsteronia Acouci** (Aubl.) A. DC. in DC. Prodr. **8**: 439. 1844.

Apocynum pictum Schrenk, Bull. Phys.-Math. Acad. Petersb. **2**: 115. 1844 = **Poacynum pictum** (Schrenk) Baill. Bull. Soc. Linn. Paris **1**: 757. 1888.

Apocynum platyanthum Salzm. *ex* Decne. in DC. Prodr. **8**: 594. 1844 = **Funastrum cynanchoides** (Gr.) Schltr. in Fedde, Repert. Sp. Nov. **13**: 284. 1914.

Apocynum proliferum Sesse & Mociño, Pl. Nov. Hisp. ed. 2. 39. 1893 = **Funastrum** sp.?

Apocynum rectinerve Salzm. *ex* Decne. in DC. Prodr. **8**: 603. 1844 = **Blepharodon pallidum** Decne. in DC. Prodr. *l. c.* 1844.

Apocynum reticulatum L. Sp. Pl. ed. 1, 214. 1753, *non* Wall. = **Parsonsia reticulata** (L.) Woodson, n. comb. (*Parsonsia Helicandra* Hook. & Arn. Bot. Beechey's Voy. 197. 1836.)

Apocynum reticulatum Wall. Cat. n. 8247. 1832, *nomen, non* L. = **Decalepis Hamiltonii** Wight & Arn. Contr. 64. 1834.

Apocynum salicifolium Medic. Act. Acad. Theod. Palat. **6**: 406. 1790 = **Gomphocarpus fruticosus** (L.) R. Br. Mem. Wern. Soc. **1**: 38. 1809.

Apocynum salicifolium Willd. *ex* Roem. & Schult. Syst. **6**: 796. 1820, *non* Medic. = **Marsdenia Clausa** R. Br. Mem. Wern. Soc. **1**: 38. 1809.

Apocynum scandens Mill. Gard. Dict. ed. 8. 1768 = **Marsdenia Clausa** R. Br. Mem. Wern. Soc. *l. c.* 1809.

Apocynum sibiricum Pall. *ex* Roem. & Schult. Syst. **4**: 405. 1819 = **Trachomitum venetum** (L.) Woodson, Ann. Mo. Bot. Gard. **17**: 158. 1930.

Apocynum soleare Noronha, Verh. Batav. Gen. ed. 1, **5**: 5. 1790 = **Strophanthus** sp.?

Apocynum speciosissimum Mill. Gard. Dict. ed. 8. 1768 = **Urechites lutea** (L.) Britton, Bull. N. Y. Bot. Gard. **5**: 316. 1907.

Apocynum stellatum Noronha, Verh. Batav. Gen. ed. 1, **5**: 51. 1790 = **Decalepis** sp.?

Apocynum stylospermum Noronha, *l. c.* 1790 = **Decalepis** sp.?

Apocynum syriacum S. G. Gmel. Reise **2**: 198. 1774 = **Calotropis syriaca** (S. G. Gmel.) Woodson, n. comb. (*Calotropis procera* Ait. Hort. Kew. ed. 2, 78. 1811).

Apocynum tiliaefolium Lam. Encycl. **1**: 214. 1783 = **Dregea volubilis Benth, ex Hook. f. Fl. Brit. Ind. 4: 46. 1885.**

Apocynum triflorum L. f. Suppl. **1**: 169. 1781 = **Astephanus triflorus** (L. f.) R. Br. Mem. Wern. Soc. **1**: 54. 1809.

Apocynum umbellatum Aubl. Pl. Guian. **1**: 275. 1775 = **Thenardia umbellata** (Aubl.) Spreng. Syst. **1**: 636. 1825.

Apocynum umbellatum Salz. *ex* Decne. in DC. Prodr. **8**: 585. 1844, *non* Aubl. = **Oxypetalum densiflorum** Decne. *l. c.* 584. 1844.

Apocynum Uralense Gandoger, Nov. Conspect. 333. 1910, *nomen.* = **Trachomitum venetum** (L.) Woodson, Ann. Mo. Bot. Gard. **17**: 000. 1930.

Apocynum venetum L. Sp. Pl., ed. 2, 213. 1753 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *anomalum* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 76. 1913 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *brachycarpum* Bég. & Bel. *l. c.* 1913 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *ellipticifolium* Bég. & Bel. *l. c.* 75. 1913 = **Trachomitum venetum** (L.) Woodson **var. ellipticifolium** (Bég. & Bel.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *latifolium* Bég. & Bel. *l. c.* 71. 1913 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *longifolium* Bég. & Bel. *l. c.* 1913 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *microphyllum* Bég. & Bel. *l. c.* 76. 1913 = **Trachomitum venetum** (L.) Woodson var. **microphyllum** (Bég. & Bel.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *oblongifolium* Bég. & Bel. *l. c.* 71. 1913 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *scabrum* Bég. & Bel. *l. c.* 76. 1913 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *turkestanicum* Bég. & Bel. *l. c.* 1913 = **Trachomitum venetum** (L.) Woodson, *l. c.* 1930.

Apocynum villosum Mill. Gard. Dict. ed. 8. 1768 = **Mandevilla** sp.?

Apocynum viminale Bassi in Comm. Bonon. (1753), *ex* Roem. & Schult. Syst. **6**: 113. 1820 = **Sarcostemma viminale** (Bassi) R. Br. Mem. Wern. Soc. **1**: 51. 1809.

Apocynum vincaefolium Burm. f. Fl. Ind. 71. 1768 = **Wrightia tinctoria** R. Br. Mem. Wern. Soc. **1**: 73. 1809. (?)

Apocynum volubile Vell. Fl. Flum. 123; **3**: *t. 88.* 1827 = **Arauja sericifera** Brot. Trans. Linn. Soc. **12**: 62. 1818.

ABBREVIATIONS

In the preceding taxonomic treatment of the genus *Apocynum*, the various herbaria in which specimens have been examined are noted as follows:

MBG = Herbarium of the Missouri Botanical Garden.
G = Gray Herbarium of Harvard University.
NY = Herbarium of the New York Botanical Garden.
US = United States National Herbarium.
F = Herbarium of the Field Museum of Natural History.
ANSP = Herbarium of the Academy of Natural Sciences of Philadelphia.
P = Herbarium of Pomona College.
D = Herbarium of C. C. Deam, Bluffton, Indiana.
W = Herbarium of the State College of Washington.
ND = Edward L. Greene Herbarium of the University of Notre Dame
NS = Herbarium of the Provincial Museum of Nova Scotia
NE = Herbarium of the New England Botanical Club.
Epling Herb. = Herbarium of Dr. Carl C. Epling.

LIST OF EXSICCATAE

The distribution numbers are printed in *italics*. Unnumbered collections are indicated by a dash. The numbers in parentheses are the species numbers used in this monograph.

Abrams, L. R. *701* (2); *1941*, *2709* (7c); *2775* (2a); *3913* (6b); *4549* (3d); *4580* (2a); *4650* (3c); *5865*, *8629* (2); *9338* (2a).
Abrams, L. R. & MacGregor, E. A. *184* (7c); *774* (1a).
Adrien, Fr. *1094* (3); *21986* (7).
Alexander, H. & Kellogg, L. *209* (2).
Anderson, E. *2700* (1a); — (3b).
Anderson, E. & Woodson, R. E. Jr. *5005* (7b); *5013* (6a); *5040* (6).
Anderson, J. P. — (6b).
Anderson, J. R. —, (1a); *500* (1a).
Andrews, L. — (3); — (6a); — (7).
Applegate, E. I. *447* (2).
Arthur, J. C. — (6); *23* (6b); — (7); — (10).
Ashe, W. W. — (1a).
Ashecroft, — (7).
Austin, Mrs. R. M. — (2); *1458* (2a); *1683* (3c).
Babcock, H. H. — (1a).
Bailey, V. *444* (3c).
Bain, S. M. *160* (6a).
Baker, C. F. — (1a); *80* (7c); *202* (1); *372* (3d); *526* (3c); *527* (1a); *799* (1a); *1122* (2); *1209* (2a); *1220* (3c); *1252* (2a); *1461* (2); *1508* (3c); *3247* (6a).
Baker, C. F., Earle, F. S. & Tracy, S. M. *429* (3d); *840* (1a).
Baker, H. P. — (7).
Baker, M. S. — (2).
Ball, J. — (1a).
Banks, R. R. *21* (1a).
Bardell, E. M. & Frye, T. C. — (1).
Barlow, B. — (1a).
Bartlett, H. H. *1124*, *1464*, *1476* (6b); *1661* (6a); *1690*, *1768* (6).
Bartram, E. B. — (1a); — (6b); — (7); *1007* (6).
Bartsch, P. — (3).
Batchelder, C. F. — (1a); — (7).
Bates, J. M. — (7).
Beardslee, H. C. — (1a).
Beattie, R. K. — (2a).
Beattie, R. K., & Chapman, R. *2067* (2).
Beattie, R. K. & Lawrence, W. H. — (2).
Bebb, R. — (6a).
Bergman, H. F. *1932* (7).
Bergmann, L. S. — (6b).
Beyerich, H. K. — (3).
Bicknell, E. P. — (3).
Bigelow, J. *691* (6b).
Biltmore Herb. *79b* (6); *80b* (1a); *79* (7).
Bissell, C. H. — (1a); — (3); — (6); — (6a); — (7).
Bissell, C. H., Pease, A. S. & Long, B. *22315* (1a).
Blake, S. F. *2844* (3).
Blanchard, S. F. — (1a); — (7).
Blankinship, J. W. — (1a); — (6b).
Blewitt, A. E. *3674* (1a).
Blumer, J. C. *1543* (1a).
Boettcher, F. L. *141* (6a).
Boice, C. A. — (1a).
Boott, W. — (1a); — (7).
Bourgeau, E. — (1a); — (7).
Brainerd, E. — (7).
Brand, C. J. *591* (1a).
Brandegee, K. — (2).
Brandegee, T. S. — (1a); *472* (6b).
Brannon, M. A. — (7b).
Bray, W. L. *216* (7).
Brewer, W. H. *1673* (7c).
Bridges, T. *160* (1).
Britton, N. L. — (1a); —, *48* (6a); — (6b).
Britton, N. L., Britton, E. G. & Vail, A. M. — (1a).
Broadhead, G. C. — (3); — (6b).
Brown, H. E. — (2).
Brown, R. B. — (2).
Brown, S. —, *655* (1a).
Bruce, Mrs. C. C. —, *2093* (6a).
Burgess, A. B. *62* (1a).
Bush, B. F. *15* (1a); *11* (3b); *159* (6b); *243*, *314* (6a); *338* (3); *359* (6b); *363* (6a); *809* (7); *916*, *2947* (3b); *4083* (6a); *5849* (6a); *5871* (1a); *7053* (6a); *7611* (7b); *7615* (3); —, *9054* (6b).

Butler, G. D. *2131* (2).
Campbell, J. E. — (1a).
Canby, W. M. — (6b); *226* (1); —, *3422* (6).
Carr, J. C. —, *95* (1a).
Carter, J. J. — (3); — (6); — (6a); — (7).
Chamberlain, E. B. — (7).
Chamberlain, E. B. & Knowlton, C. H. — (7).
Chandonnet, Z. L. — (1a).
Chaney, R. W. *92* (1a).
Chapman, A. W. — (6b).
Chase, A. — (1a).
Chase, V. H. *647* (1a); *631* (6a).
Chestnut, V. K. & Drew, E. R. — (7c).
Churchill, J. R. — (1a); — (3).
Clark, J. A. *101* (2); *113* (6b); *243*, *330* (2).
Clemens, Mrs. J. E. — (1); — (2); — (3b); — (1a); — (7c); *11728* (6b).
Clements, F. E. & Clements, E. S. *107*, *398* (1a).
Clitherall, —. — (7).
Clute, W. N. *87* (5).
Coghill, G. E. *96* (1a).
Coker, W. C. — (6a).
Collins. J. F. & Fernald, M. L. — (3); — (7).
Collins, J. F., Fernald, M. L. & Pease, A. S. — (3); *5877* (1a).
Collins, J. F. & Hope, T. — (3).
Commons, A. — (1a); — (6).
Conger, K. — (2).
Copeland, E. B. *3544* (2).
Cotton, J. S. *1399* (6b).
Coues, E. & Palmer, E. — *332* (6b).
Coville, A. L. — (6b); — (7).
Coville, F. V. — (1a); — (7).
Cowles, H. C. *380* (2a).
Cowley, K. — (2).
Crandall, C. S. — (3c); — (6b); *1013* (1).
Crawford, D. L. — (1a).
Cronkhite, H. M. *76* (2).
Culbertson, — *4472* (2).
Curtis, C. D. — (1a).
Curtiss, A. H. — (1a).
Cushman, J. A. & Sanford, S. N. F. *1621*, *1296* (1a).
Daniels, F. *409* (3c).
Davis, J. *1326* (6b); *2263* (3b); *2947* (6a); *2969* (3b); *4762* (6a); *4984*, *8426* (6).
Davison, R. T. — (2).
Day, M. A. *19*, *70* (1a); — (7).
Deam, C. C. — (1a); — (3); — (6a); — (6b); — (7); — (7a); *11* (6); *73* (3); *1125* (1a); *1168* (7a); *2276*, *6901* (6); *8489* (6a); *8848*, *8923*, *8997* (1a); *9135*, *11566* (6b); *11902* (3); *12405*, *13280*, *13500* (7); *13517* (6a); *13562* (6); *13673* (6a); *13766* (6b); *13806* (6a); *14283* (1a); *17004* (6b); *17217* (6); *17555* (6b); *17879* (3); *20346* (6a); *20524* (6); *20571* (3a); *20972*, *21571* (3); *25230* (6a); *25405* (6); *25609* (7); *25647* (6a); *25904*, *25905*, *27862* (3); *31710* (1a); *31973*, *32972* (7); *34434*, *39168* (3a); *41020* (3b); *41320*, *41342* (1a); *44912* (6a).
Deam, C. C. & Gleason, H. A. — (7a); — (6a).
Dodge, C. K. — (3a).
Donnell-Smith, J. — (1a); — (7).
Dorner, H. B. — (3).
Driggs, A. W. — (1a); —, *2326* (7).
Drummond, T. *232* (6b).
Drushel, J. A. *2434* (1a).
Dutton, E. L. — (6b).
Eames, A. J. & McDaniels, L. H. *964* (7); *4832* (3).
Eames, A. J. & Wiegand, K. M. *12761* (6a).
Eames, E. H. — (1a); — (6); — (6a); *8786* (3).
Earle, F. S. *1644* (6a).
Eastwood, A. *71* (5a); *542*, *906* (3c); *13363* (2).
Eaton, L. O. — (3); — (6).
Eby, A. F. — (1a); — (6b).
Eggert, H. — (1a); — (3); — (6a); — (6b).
Eggleston, W. W. *3291* (1a); *4805* (6a); *4872* (7).
Eggleston, W. W. & Grout, A. J. *2060* (7).
Ehlers, J. H. *559* (1a).
Eisenhower, C. W. — (6b).
Elmer, A. D. E. — (5); *138* (1); *285* (3c); *507* (6b); *2216* (1); *3180* (7c); *6863* (1).

Elrod, M. J. — (1a).
Emig, W. H. *378* (7).
Engelmann, G. — (1a); — (2); — (6b); — (7).
Engelmann, H. — (6b); — (7b).
English, C., Jr. *775* (2).
Epling, C. C. *5574*, *6088*, *7182* (1a); *10426* (2); *10461* (3c).
Epling, C. C. & Houck, M. — (2); *9402* *10004* (3c).
Epling, C. C., Houck, M. & Putnam, —. *10119* (2).
Evans. W. H. — (1).
Evermann, B. W. — (6).
Farwell, O. A. — (1a); — (3); — (6); — (7a).
Farwood, —. *252* (1).
Faxon, C. E. — (1a); — (7); — (11).
Fendler, A. — (1a); *690* (1); *690.6* (3); *692* (6b).
Fernald, M. L. — (1); — (1a); — (3); *37* (7); *245* (1a); *375* (6b); —, *2073*, *2074*, *2076* (7); *2075* (3).
Fernald, M. L. & Bissell, C. H. *22316* (3).
Fernald, M. L., Dodge, C. W. & Smith, L. B. *25988* (1a).
Fernald, M. L., Hunnewell, F. W. 2d., & Long, B. *10241* (6a); *10243* (3).
Fernald, M. L. & Long, B. *10240* (1a); *10241* (6a); *14398*, (1a); *14399* (3); *14402*, *14404*, *14406* (7); *14400*, *19008*, *24392* (3).
Fernald, M. L. & Pease, A. S. *25241* (7).
Fernald, M. L. & St. John, H. *7950* (1a).
Fernald, M. L. & Wiegand, K. M. *6087*, *6088* (1a); *6089*, *6090* (3); *6092* (7).
Ferris, R. S. & Duncan, C. D. *2542* (1).
Fink, B. — (1a).
Fisher, G. L. — (6a).
Fitch, A. — (1a); — (6b); — (7).
Forbes, F. F. — (7).
Fowler, J. — (7).
French, C. — (6).
Fuller, T. O. — (7).
Furbish, K. — (1a); — (3); — (7).
Garesche, E. E. — (1a).
Garrett, A. O. *2450* (1); *2915* (3c).
Gilmour, J. — (1a).
Glatfelter, N. M. — (1a); — (6a); *338*, (6b).
Gleason, H. A. —, *336* (1a); *687* (7).
Goldman, E. A. *1221* (1a).
Goodding, L. N. *120* (1a); *986* (7c); *1127*, *1622* (1a).
Goodwin, L. L. *12* (2a).
Grant, J. M. — (1a); — (2a).
Graves, C. B. — (3); — (6a).
Gray, A. — (6b).
Greene, E. L. — (1a); — (2); — (2a); — (3); — (3c); — (3e); — (6); — (6a); — (6b); — (7).
Greenman, J. M. *616* (1a); *1437* (1a); *1438* (6a); *1864* (1a); *1869* (6b); *2815*, *3106* (1a); *4594* (6b).
Greenman, M. T. *52* (1a).
Griffiths, D. — (1a); *5397* (6b).
Grinnell, J. *78* (1a).
Griswold, —. *1* (6).
Gunison, —. — (7).
Haberer, J. V. *2202* (7); *3559* (3).
Hale, —. — (6); — (6b).
Hall, E. *427* (2a); *514* (6b).
Hall, H. M. & Chandler, H. P. *146* (2).
Hammond, E. W. *274* (2a); *275* (3e).
Hanson, G. — (2); *27*, *585* (3c); *938*, *969* (2).
Hanson, H. C. *158* (3); *276* (1); *277* (3c).
Harms, E. L. — (2a).
Harris, J. A. *16394* (1a).
Harrison, L. C. — (1a).
Harwood, R. D. *4328* (3d).
Hasse, H. E. — (6a); — (6b).
Hedgcock, G. G. — (6b); — (7c).
Heller, A. A. — (2a); *464* (6a); *970* (6); *7050* (2a); *8109* (7c); *8110* (3c); *7518* (7c); *6036* (2a); *9815* (3c); *9940* (5); *5732* (6b); *10612* (5); *10779*, *10417* (7c); *10883* (3c); *10982* (1); *11532* (7c); *11978* (2a); *11936* (2); *12753*, *12887*, *12963* (2a); *13067*, *13345*, *13753* (2); *13988* (7b); *13998*, *14103* (6a); *14204*, *14232* (1a); *14239* (6a); *14240* (7); *14258* (1a); *14261* (3).
Heller, A. A. & Halbach, G. *1039* (7); *3338* (2a).
Henderson, L. F. *310* (2); *649* (6b).
Hexamer, A. C. & Maier, F. W. — (6a).
Hicks, —. — (7).

Hill, A. F. *1540* (1a).
Hillman, F. H. — (2).
Hitchcock, A. S. — (1a); — (6); — (6a); *12909* (6b); — (7).
Hoar, E. S. — (3).
Hoffman, R. — (3); — (6); — (6b); — (7).
Holm, Theo. — (3).
Hooker, J. D. — (2a); — (7).
Hooker, J. D. & Gray, A. — (2).
Hope, T. — (7); 453 (1a).
Horner, R. M. *334* (2).
House, H. D. *1007* (6a); *1208* (1a); *1060* (6); *2822* (7); *8100* (7a); *8294* (1a).
Howe, E. L. — (1a); — (7).
Howell, A. H. — (1a).
Hoyt, R. W. — (3c).
Hubbard, F. T. — (1a).
Illick, J. — (1a); — (3).
Jensen, M. C. — (1a); *7* (6).
Jepson, W. L. — (2a).
Jermey, G. *196* (6).
Johnson, A. G. — (1a); — (6b); — (7).
Johnson, E. L. *246* (7c); —, *295* (6b).
Johnston, I. M. *2871* (2).
Jones, M. E. — (1); — (1a); — (2); — (3c); — (4); — (5); — (6b); — (7c); *237* (3c); *572* (1); *1272*, *1863* (5); *5490* (6b); *5490*, in part, (7c); *5560*, *5613* (1); *6447* (2); *8878* (7c); *8880*, *8881* (1).
Jones, W. W. — (1); *79* (7c).
Kammerer, A. L. — (1a); — (2); *71* (6b); *103* (2).
Kearney, T. H. *1472* (6).
Keller, J. A. — (1a).
Kellogg, A. & Harford, W. G. *842* (1a); *4870* (2).
Kellogg, J. H. — (1a); — (6); — (6b); *470* (6); *471* (3b).
Kelsey, J. A. *158* (3).
Kennedy, G. G. — (1a); — *50* (3).
Kennedy, P. P. *1916* (2).
Kent, E. C. — (1a); — (7).
Keyes, E. — (2).
King, M. A. *247* (3c).
Kirkwood, J. E. *1252*, *1253*, *1594* (2).
Knowlton, C. H. — (1a); — (7).
Kreager, F. O. *89* (1a).
Lake, —. & Hull, W. R. *542* (3d).
Lane, W. C. — (1a).
Langlois, A. B. — (6b).
Lansing, O. E. *2543* (7); *2679* (6b). (1a); *2769* (7); *2820* (1a); *2992* (6b); *3171* (6a); *3183* (3); *3213* (1a).
Lapham, I. A. — (7).
Laybourne, W. A. *86* (6b).
Leiberg, J. B. — (3c); *1500* (1); *1546* (2); *1557* (6b); *1565* (3c).
Leick, M. — (5).
Lemmon, J. G. — (1a).
Leonard, F. E. — (1).
Letterman, G. W. — (1a); — (6); — (6a).
Lewis, I. F. *220* (6a).
Lindheimer, F. *658* (6b); *659* (6).
Lindsay, A. W. H. — (7).
Lloyd, C. G. — (3); *296* (6a).
Lucy, T. F. *5389* (6b).
Lunell, J. — (1a); — (6b); — (7); — (7b).
Lyall, D. — (1a); — (7).
Lyon, W. J. — (6b).
Mabbott, —. *257* (6a).
Macbride, J. F. *247* (7c); *549* (1).
Macbride, J. F. & Payson, E. B. *3040* (2); *3327* (1).
MacDougal, D. T. *254* (1a).
Mackenzie, K. K. — (3); *200* (3b); *253*, *2125* (6b); *2290* (1a); *3093* (6a); *3102* (1a); *3468* (7).
Mackenzie, K. K. & Griscom, L. *10413* (7).
Macoun, J. — (1a); —, *171*, *5416*, *54293* (7); *14156*, *66554* (7c); *66555* (3a); *68532* (7).
Macoun, J. & Herriot, W. *78489* (7c).
Martin, L. R. — (1a).
Mathias, M. E. *275* (6); *536* (3d); *558* (7c).
Maxon, Mrs. S. W. *4541* (1a).
Maxon, W. R. — (6b).
McClatchie, A. J. — (2a).
McDonald, F. E. — (3).
McFarland, F. T. *131* (6a).
McGregor, E. A. *32* (2).
Mearns, E. A. — (1a).
Mell, C. D. *23* (1a).
Mell, C. D. & Knopf, —. — (7).
Menke, H. W. — (7).

Meredith, H. B. — (1a); — (6).
Merrill, E. D. & Wilcox, E. N. *1042* (6b); *1084* (1a).
Metcalfe, O. B. *132* (5a); *981* (1a); *1070* (5a).
Miller, G. S. — (6a); — (10a); *1, 2, 3* (3).
Milligan, Mrs. —. (1a).
Monell, A. W. — (6b).
Moodie, M. E. — *116* (6b).
Moore, A. H. *2097* (6b).
Morong, T. — (1a).
Mosely, E. L. — (1a).
Mulford, I. — (1); — (1a).
Munz, P. A. *599* (1a); *601* (6a); *4517* (7c); *8274* (2a); *8324* (7c); *8417* (6b).
Munz, P. A. & Johnston, I. M. *8596* (1a).
Murdock, J. *4214* (1a); *4330* (7).
Nelson, A. *596* (7); *7329, 9491* (1a).
Nelson, A. & Macbride, J. F. *1361* (6b).
Nelson, A. & Nelson, E. *6206* (1a); *6923* (7c).
Nelson, E. *535* (1); *2027* (1); *4901* (7c).
Nelson, E. W. *6012* (3c).
Nelson, J. C. *1594* (2a); *2284* (3c).
Newcombe, C. F. *293* (7c).
Nichols, G. E. *289* (1a); *345* (7).
Nieuwland, J. A. — (1a); — (3); *10379* (7); *11316* (6a); *11602* (3); *11603* (6a).
Nieuwland, J. A., Slavin, A. & Woodson, R. E. Jr. *1* (3); *2* (1a); *3* (6a).
Norris, W. — (6a); — (6b); — (7).
Norton, A. H. — (7).
Norton, J. B. S. —, *324* (6a).
Nuttall, T. — (2); — (2a).
Oakes, W. — (6).
Olney, S. T. — (6).
Osterhout, G. E. — (5).
Pace, L. *472* (1a).
Palmer, E. *220* (6b); *511* (5); *2522* (2).
Palmer, E. J. *208, 965* (6b); *2119, 2172* (1a); *2336* (6a); *3188* (6b); *3418a* (3); *3426* (6a); *4006* (6b); *5792* (6); *6092* (6a); *8133* (6b); *9893* (6); *12420* (6b); *13849, 13926* (7); *17528* (6a); *18293* (3); *18311* (6b); *23248* (1a); *28651* (1a); *3188* (6b); *34081* (3c); *34233* (7); *34676* (6a); *34692* (1a).
Palmer, W. — (3); *7* (6a).
Pammel, L. H. — (7b); *5* (1); *864* (1a).
Pammel, L. H. & Blackwood, R. E. *4009* (6b).
Pammel, L. H. & Stanton, E. M. *71* (1).
Parish, S. B. *11427* (6b).
Parlin, J. C. — (3); *2386* (7).
Parry, C. L. — (6a).
Patterson, H. J. *6863* (1).
Payson, E. B. *116* (7c); *178* (1a); *1172* (1a).
Payson, E. B. & Armstrong, G. M. *3382* (2).
Payson, E. B. & Payson, L. B. *1886, 2170, 2186* (1).
Peacock, B. R. *56* (7c).
Pease, A. S. *1089, 2267, 11332* (7); *17345* (1a); *17383* (3); *18104* (7).
Pease, A. S. & Long, B. *22317* (7).
van Pelt, S. S. — (1a).
Peck, M. E. *2945* (2a); *8004* (2); *8944* (*2a*); *10172* (3c).
Penard, —. *500* (1).
Perry, R. C. — (1a); — (6a).
Peter, R. — (6b).
Phelps, O. P. — (1a); *783, 1690* (7).
Pierce, W. M. — (1a).
Piper, C. V. *3508* (2); *3702* (6b); *3786* (1).
Plank, E. N. — (6b).
Pollard, C. L. & Maxon, W. R. — (6b).
Pollock, W. M. — (1a); — (6c).
Pool, R. & Williams, —. — (3).
Poole, S. F. *36* (6b).
Poole, S. F. & Folsom, —. — (7).
Porter, T. C. — (6); — (6b); — (7).
Powell, H. O. — (1a); — (7).
Preble, E. & Preble, A. *175* (1a).
Preble, E. & Mixter, G. *549* (1a).
Prescott, H. S. — (2).
Price, S. F. — (6b).
Quaintance, A. L. — (6b).
Rand, E. L. — (1a).
Randolph, L. F. & Randolph, F. R. *481* (6); *1240* (7); *1356* (6b).
Ransom, B., & Ridout, L. *146* (7c).
Rau, E. A. *66* (1a).
Ravenel, H. W. — (6a).
Redfield, J. R. *4871* (6a).

Reverchon, J. — (3); —. *599* (6b); *4309* (7).
Rhoads, S. W. — (1a).
Ricksecker, —. — (6).
Ridgway, R. *2832* (6b).
Robinson, B. L. — (7); *11* (3); *135* (7); *362* (6); *563* (6b); *741* (1a).
Robinson, B. L. & Schrenk, H. [von] *96* (1a).
Robinson, C. B. *502* (7).
Robinson, T. R. & Maxon, W. R. *37* (1a).
Rolfs, P. H. *720* (3).
Rolland, Fr. *142* (7).
Rolland, Fr. & Germain, Fr. — (7).
Rose, J. P. *2* (1a); *1382* (2).
Rosendahl, C. O. *1835* (1a).
Rothrock, J. T. & Wolf, —. *45* (1a).
Rusby, H. H. — (6a).
Rust, H. J. *247* (1).
Ruth, A. *387*, *463* (6a); *481* (6b); *501* (6); *3088* (6a).
Rydberg, P. A. — (6b); —, *95*, *130* (1a); *871* (1); *1353* (7); *6772*, *7761* (1); *7892* (3).
Rydberg, P. A. & Bessey, E. A. *4701* (1).
Rydberg, P. A. & Vreeland, F. R. *5756* (1a).
Sandberg, H. J. — (1a); — (6b).
Sandberg, H. J. & Leiberg, J. B. *591* (3c).
Sandberg, H. J., MacDougal, D. T. & Heller, A. A. *372* (2); *825* (7c).
Sanford, S. N. F. — (1a).
Sartwell, H. P. — (3).
Saunders, W. E., Anderson, E. & Woodson, R. E., Jr. — (1a).
Savage, T. E. & Steele, E. S. *310* (1a).
Savage, T. E., Cameron, F. E. & Lenocker, J. E. — (2a).
Scheuber, E. W. — (1a); *1* (1).
Scheutte, J. H. — (1a); — (6a); — (7).
Schenck, — (6).
Schrenk, H. [von] — (1a); — (6b).
Scribner, F. L. *151* (7c); *152* (2).
Seymour, F. C. *53*, *1431* (1a); *200* (6b).
Sharples, S. P. *181* (2).
Shaw, C. H. *680* (1); *1064* (1a).
Shear, C. L. *88* (7); *4808* (6b).
Sheldon, E. P. *8208* (1).
Short, C. W. — (6b).
Shull, G. H. *109*, *173* (6b).
Sinnott, E. W. — (3).
Sleeper, T. S. — (1a).
Small, J. K. — (6); — (7).
Smiley, F. J. *247* (3c).
Smith, B. H. — (1); — (2).
Smith, E. C. — (1a); — (7).
Smith, E. F. — (3); — (7).
Smith, H. H. *5935* (7); *6013* (2a).
Smith, L. E. *571* (2a).
Snyder, J. B. *217* (1a).
Soper, M. — (2a).
Spaulding, Rev. —. — (7c).
Spencer, M. F. *995* (5); *2360* (7c).
Sprague, R. —, *426* (2); *425* (2a).
Standley, P. C. *14* (7c); *1070* (5a); *4102* (1a); *5044* (5a); *13989* (3c); *15553* (2); *16845*, *17846*, *18821* (1).
Stanfield, S. W. — (6b).
Steele, E. S. — (3).
Steele, E. S. & Steele, Mrs. —. *238* (1a).
Stevens, G. W. *798* (6b); *2105* (6a).
Stinchfield (Ferris), R. *373* (6b).
St. John, H. *1439* (7); *2880* (3); *4458* (2).
St. John, Mrs. O. *42* (1a).
Straub, —. — (6).
Sturtevant, E. L. — (1a); — (6).
Suksdorf, W. — (1a); — (2a); *1522* (5); *4049* (3d); *5133* (2); *5134* (2a); *11414*, *11692* (2).
Sullivant, E. — (1a).
Suttie, —. — (3a).
Sykes, Dr. —. — (7b).
Tatnall, E. — (7).
Taylor, B. C. — (1a).
Thone, F. H. *33* (6b); *61* (1a).
Thornber, J. J. — (7c).
Throop Herb. — (6a).
Thurber, G. *222* (3c).
Tidestrom, I. *9157* (6b); *10255* (2); *10727* (5); *10791* (7c); *11516* (6a).
Torrey, G. *748* (1a).
Torrey, J. — (6a).
Townsend, C. H. T. & Barber, C. M. — (3c); *33* (1a).
Tracy, S. M. *9449* (6b).
Tracy, S. M. & Earle, F. S. *286* (7c).
Treakle, Mrs. A. F. *159* (1).
Trelease, W. — (1a); *709* (6a); — (6b).
Tweedy, F. *4640* (2); *3475* (3c).
Umbach, L. M. *371* (3c).

Underwood, — (7).
Vasey, G. R. — (7c); *429* (2a); *430* (3c).
Vesey, L. J. X. de *100* (7c).
Vestal, A. G. — (3c).
Victorin, Fr. Marie, *9652* (1a); *15740, 15741, 15742* (7).
Victorin, Fr., Brunel, Fr., Rolland, Fr., Germain, Fr. & Rousseau, Fr. *17337* (7).
Victorin, Fr. & Germain, Fr. *21988* (1a).
Viereck, H. L. — (6).
Vogel, J. — (3c).
Vorhies, C. T. *44* (5).
Waghorne, A. C. — (1a).
Walker, E. P. *191* (7c).
Ward, L. F. — (6b).
Ware, R. A. — (1a).
Watson, S. — (2).
Watt, G. H. — (5).
Weatherby, C. A. *4324* (3).
Webb, R. — (6b).
Webber, H. J. — (1a); — (6b).
Wheeler, L. A. — (7); *2* (3).
White, O. E. — (1a).
Whited, K. *142* (1); — (5); — (2); *1423* (3c).
Wiegand, K. M. *3038* (7); *12760* (6a).
Wiegand, K. M. & Hentley, M. — (3).
Williams, E. F. — (1a); — (3); — (6a); — (7); — (6b); *1* (1a).
Williams, E. F., Collins, J. F. & Fernald, M. L. — (1a); — (3).
Williams, E. F. & Fernald, M. L. — (3).
Williams, T. A. — (1); — (7b).
Williamson, C. S. — (2); — (3); — (6b); *1692* (1a).
Williamson, E. B. — (1a).
Winslow, E. J. — (3).
Wislizenus, F. *458* (7c); *496* (3c); *579* (1a).
Witham, H. —, *8990* (2).
Woodson, R. E. Jr. *681, 1660, 1650* (6b); *1651* (1a); *1655, 1656, 1672, 1676, 1679, 1682* (6); *1686* (7); *1698* (6b); *1713, 1714* (1a); *1719, 1729* (6a); *1730* (6); *1740* (7b); *1746* (6); *1745, 1747, 1748* (6b); *1809* (3c); *1822* (1a); *1917* (1); *1926* (6a); *2703* (6); *29162* (7).
Woodson, R. E. Jr., & Anderson, E. *1541* (6a); *1548* (6b); *1549* (6a); *1551* (6); *1608* (6a); *1701* (6); *5205* (7c); *28988* (7); *29001* (3d); *29002* (1a); *29007* (3d); *29075* (5); *29089* (1a); *29100, 29109* (7c); *29112* (1a); *29120* (1); *29123* (1a).
Woodson, R. E. Jr., & Barnhart, F. C. *29028* (3d); *29029* (7c); *29030* (3c); *29032* (1b).
Woodson, R. E. Jr. & Fuller, H. J. *1653, 1696* (3b).
Wooton, E. O. — (1); — (1a); — (7c); *113* (3c).
Wooton, E. O. & Standley, P. C. *3451* (3).
Wright, A. H. —, *12759* (7).
Wright, A. H. & Griscom, L. *10620* (6b).
Wright, W. F. *229* (1a).
Wurtson, J. B. — (1).
Yates, H. — (2).
Young, —. — (7).
Zeller, S. M. — (2a).
Zeller, S. M. & Zeller, E. B. *1187* (1a).

III. Trachomitum: A New Genus of Apocynoideae

In their 'Revisione Monografica del Genere *Apocynum* Linn.', Béguinot and Belosersky treat the Eurasian species and varieties of the Linnean genus *Apocynum* as representing a section analogous to their sections *Androsaemifolii, Cannabini, Hypericifolii,* and *Medii,* which, as we have already shown, are so confluent and vague that they do not merit the distinction of denomination. In founding their section *Veneti* to accomodate the Eurasian

representatives of the genus related to *Apocynum venetum* L., those authors epitomize it as follows:[98]

> "It is characterized by the elliptical-oblong foliage, narrow or broad, short or elongate, of delicate or somewhat coriaceous texture, minutely but distinctly denticulate, always incised along the margin with minute denticules, and otherwise glabrous: by the cylindrical-campanulate corolla, of medium size, and a trifle nodding."

To judge merely from the analysis quoted above in direct translation from the Italian of Béguinot and Belosersky, the Eurasian species and varieties of the Linnaean genus *Apocynum* are separable from the North American species and varieties only by the foliage. Actually, however, those two elements are so distinct in their floral organs and inflorescence that they are deemed to merit generic distinction. For reasons which have been advanced in the preceding section concerning the emended genus *Apocynum*, the North American element has been shown to be the typical and traditional element of the genus. Therefore the Eurasian element, represented in the Linnaean genus *Apocynum* by *A. venetum* L. is proposed as a new genus.

Trachomitum,[99] n. gen. of the Apocynaceae.

Herbaceous lactescent perennials from somewhat thickened fibrous rhizomes. Stems erect or ascending, cylindrical, striate, glabrous; branches ascending, subalternate. Leaves opposite, or occasionally subopposite, petiolate, oblong-ovate to linear-lanceolate, membranaceous, coriaceous-denticulate along the margins, and frequently also along the midrib of the lower surface, mucro-

[98] Bég. & Bel. Atti R. Accad. Lincei, V. 9: 67. 1913. "È caratterizzata per le foglie ellittico-oblunghe, strette o larghe, corte od allungate, a tessitura debole od anche un po' coriacee, brevemente ma distintamente picciolate, sempre incise ai margini da minuti dentini, e nel resto glabre: per la corolla cilindrico-campanulata, mediocre, a lobi rotondati, ed un po' curvati in fuori."

[99] **Trachomitum** Woodson, gen. nov. Apocynacearum. Calyx 5-partitus hispidulosus, disco non adnatus, eglandulosus. Corolla cylindrica granulo-papillata, limbo 5-partito aestivatione dextrorsum contorta, squamellis 5 coalescens in tubo corollae insertis. Stamina 5 tubo corollae affixa inclusa cum corollae sequentis alternatis, filamentis brevibus ellipsoideo-cylindricis, antheris sagittatis basi cum auriculis vergentibus instructis. Ovarium bilobum, lobis singularibus unilocularibus, ovulis in quoque loculo binis superpositis. Nectaria 5 integra supra discum propriam intra tubum calycis immersum. Folliculis teretes recti vel falcati.—Herba perennis e rhizomate horizontali erecta ramosa, ramis ascendentibus plerisque alternis. Folia opposita petiolata membranacea coriaceo-denticulata penninervia. Cymae pedunculatae terminales plus minusve compositae hispidulosae.

nate, penninerved; petioles bearing 2–4 small, attenuate, pectinate glands at the base. Inflorescence a terminal pedunculate bracteate hispidulous monochasial cyme. Calyx regularly 5-parted, hispidulous, the tube adherent but not adnate to the receptacle, eglandular within. Corolla cylindrical to cylindrical-campanulate, regularly 5-parted, very conspicuously granulose-papillate, bearing within 5 apiculate appendages coalesced into a ring and adnate to the base of the tube, the apices opposite the lobes of the corolla-limb; limb erect or spreading, dextrorsely convolute in the bud. Stamens 5, alternate with the apiculi of the appendicular ring and attached to the base of the corolla-tube, convergent about the pistil; anthers of two small unilocular sporangia borne ventrally near the apex of an enlarged sagittate, auriculate, peltately stipitate connective; auricles of the anther-connective convergent, with a closed sinus; filament short, flattened; pollen borne in tetrads, mostly sterile. Carpels 2, unilocular, sessile, united at the apices by an ovate-cylindrical clavuncle bearing the terminal binate stigma; ovules many, anatropous, borne upon a ventral, lateral, binate placenta. Receptacle somewhat elevated above the orifice of the calyx-tube, variously lobed, scarcely entire; nectaries 5, separate, ovate-cylindrical, situated upon the receptacle in a ring about the carpels. Follicles 2, divaricate, terete, somewhat falcate, pendulous, containing many dry, apically comose, terete, exalbuminous seeds; embryo straight.

Type species: *Trachomitum venetum* (L.) Woodson.

KEY TO THE SPECIES

a. Corolla cylindrical-campanulate, the tube dilating conspicuously, corolla-lobes equalling, or nearly equalling the length of the tube; calyx-lobes oblong-lanceolate; inflorescence relatively few-flowered and dense.
  b. Leaves relatively large, 3–5.5 cm. long.
    c. Leaves lanceolate to oblong-lanceolate .... *1. T. venetum*
    cc. Leaves ovate to oblong-ovate............. *1a. T. venetum* var. *ellipticifolium*
  bb. Leaves relatively small, 1–1.5 cm. long...... *1b. T. venetum* var. *microphyllum*
aa. Corolla cylindrical, the tube not dilating; corolla-lobes about one-third the length of the tube; calyx-lobes ovate-deltoid; inflorescence many-flowered and loose.. *2. T. sarmatiense*

1. Trachomitum venetum (L.) Woodson, n. comb.

Apocynum venetum L. Sp. Pl. ed. 1, 213. 1753; Sibth. Fl. Graec. **1**: 166. 1806; Roem. & Schult. Syst. **4**: 405. 1818; Rchg.

Fl. Lid. Ven. 68. 1818; Biebers. Fl. Taur.-Cauc. **3**: 173. 1819; Moric. Fl. Ven. **1**: 128. 1820; Roehl. Mert. & Koch, Deutschl. Fl. **2**: 291. 1824; Nacc. Fl. Ven. **2**: 52. 1827; Host, Fl. Austr. **1**: 315. 1827; Reichenb. Ic. Fl. Germ. & Helv. **2**: 429. 1831; Bert. Fl. Ital. **3**: 16. 1837; A. DC. in DC. Prodr. **8**: 440. 1844; Ledeb. Fl. Ross. **3**: 43. 1846; Boiss. & Buhse, Pl. Pers. 147. 1860; Boiss. Fl. Or. 48. 1879; Hook. Fl. Br. Ind. **4**: 657. 1882; Parl. Fl. Ital. **6**: 713. 1884; Aitch. Bot. Afghan. Delim. Comm. 87. 1887; Archangeli, Comp. Fl. Ital. 364. 1894; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4^2: 179. 1895; Fiori & Paoletti, Fl. Anal. Ital. **2**: 343. 1900; Kusn., Busch & Fomin, Fl. Cauc. 4^1: 428. 1903; Krylof, Fl. Alt. **3**: 827. 1904; Bég. & Bel. Atti R. Accad. Lincei V. **9**: 69. 1913; Fiori, Nuova Fl. Anal. Ital. **2**: 245. 1926.

Asclepias rubra Sievers in Pall. Fl. Nord. Beitr. **7**: 329. 1771.

Apocynum syriacum Gmel. Reise Russ. **2**: 198. 1774, *non* Clus.

Apocynum androsaemifolium Forsk. Fl. Aeg.-Araò. 22. 1775, *non* L.

Nerium sibiricum Medic. Beobacht. 15. 1782.

Apocynum compressum Moench, Meth. 464. 1794.

Nerium antidysentericum Lepech. Reise **1**: 270. 1800.

Apocynum sibiricum Pall. *ex* R. Br. Mem. Wern. Soc. **1**: 68. 1809, *non* Jacq.; Roem. & Schult. Syst. **4**: 405. 1818; Ledeb. Fl. Alt. **1**: 235. 1829; Bongd. & Meyer, Suppl. Fl. Alt. 181. 1841; Karel. & Karil. Enum. Pl. Soong. 542. 1842.

Apocynum venetum L. var. *latifolium* Rchb. Ic. Fl. Germ. & Helv. **17**: 16. *t. 24*. 1855; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 71. 1913.

Apocynum venetum L. var. *typicum* Bég. & Bel. *l. c.* 69. 1913.

Apocynum venetum L. var. *oblongifolium* Bég. & Bel. *l. c.* 71. 1913.

Apocynum venetum L. var. *longifolium* Bég. & Bel. *l. c.* 1913.

Apocynum venetum L. var. *wolgense* Fischer *ex* Bég. & Bel. *l. c.* 72. 1913. *nomen.*

Apocynum venetum L. var. *anomalum* Bég. & Bel. *l. c.* 76. 1913.

Apocynum venetum L. var. *turkestanicum* Bég. & Bel. *l. c.* 76. 1913.

Apocynum venetum L. var. *scabrum* Bég. & Bel. *l. c.* 1913.

Apocynum venetum L. var. *brachycarpum* Bég. & Bel. *l. c.* 77. 1913.

Stems erect or ascending, 3–10 dm. tall, glabrous, freely branched; branches subalternate, ascending; leaves opposite or subopposite, petiolate, lanceolate, acute to obtuse at the base, acuminate to acute at the apex, glabrous, denticulate, membranaceous, mucronate or without a mucro; inflorescence relatively few-flowered, bracts conspicuous, persistent, frequently semifoliaceous; corolla cylindrical-campanulate, the tube 4–5 mm. long, 3–5 mm. broad, dilating toward the orifice, the lobes oblong to oblong-lanceolate, equalling or nearly equalling the length of the tube, spreading; calyx-lobes hispidulous, lanceolate to oblong-lanceolate, 2–2.5 mm. long; follicles terete, 5–10 cm. long, somewhat falcate, pendulous.

Distribution: sparingly upon the shores of the Adriatic, Aegean, and Black Seas in Europe; generally throughout central Persia, Turkestan, India, and China, to the shores of the Yellow Sea. Largely plants of maritime and alkaline situations.

Specimens examined:

Italy: "in arenosis maritimis propre Venetias," July, 1880, *Penzig 1169* (G); Venetia, July 10, 1908, *Fiori & Beguinot 1109* (G); "ex maritimis Venetis, al Lido," June 22, 1868, *Ball* (G, MBG, NY); sand-dunes, Lido, Venice, May 25, 1906, *Pease 9213* (G); Lido, Venice, July 21, 1878, *Martens* (G); "in collibus arenosis ad litus maris Adriatici propre Grado," date lacking, *Pichler 188* (G); Sicily, June, 1871, *Gandoger 1661* (MBG, US); Aquileia, date lacking, *Bernhardi Herb.* (MBG); "Monfalcone ad litus maris," June, year lacking, *Lagger* (MBG); shores of the Adriatic Sea near Monfalcone, June 25, 1867, *Ascherson* (MBG); Venice, date lacking, *Burkhardt* (ANSP); Lido, Venice, 1840, *Kettner* (NY); Trieste, June, 1868, *Prihler* (US); seashore, Monfalcone, June 25, 1882, *Kammerer* (US); Venice, Spiaggia di Alberone, July, 1910, *Vaccari* (US); Trieste, June 11, 1895, *Engelhardt* (US).

Russia: Uralsk, date lacking, *Burmeister* (US, ANSP, NY); Lakon, Turkestan, Aug. 22, 1879, *Nervessky* (NY, US); Lepsinsk, July 25, 1891, *Timsfegen* (US); Turkestan, exact locality lacking,

June 3, 1884, *Regel* (NY); Kiufer, Turkestan, May 30, 1877, *Regel* (ANSP); Kakiansu, Turkestan, Aug. 24, 1878, *Regel* (NY); "southern Russia," exact locality and date lacking, *Fischer 84* (NY); Lenkoran and Kisilagatsch, July 8, 1838, *Hohenacker* (US).

TURKEY: Anatolia, exact locality and date lacking, *Wiedemann* (US); Smyrna, 1890, *Ball* (G); Amadia, Aug. 13, 1841, *Hohenacker* (G); exact locality lacking, July-Aug. 1841, *Grout & Hemsdall* (NY).

PERSIA: Szovis, *Herb. Hort. Petrop.* (G); Teheran, June 24, 1843, *Hohenacker 397* (MBG).

CHINA: "Songaria ad lacum Saisang-Nor," *Herb. Acad. Petrop.* (G); Chefoo, 1883, *Perry* (G); Ajagus, Soongaria, 1867, *Schrenk* (NY); Chu Kou, Shansi, June 30, 1925, *Ling 9114* (US); Dschues-Ahatsch, Soongaria, 1841, *Karelin & Kiriloff* (NY); environs of Pekin, date lacking, *David* (ANSP).

1a. Trachomitum venetum (L.) Woodson var. **ellipticifolium** (Bég. & Bel.) Woodson, n. comb.

Apocynum venetum L. var. *ellipticifolium* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 75. 1913.

Leaves ovate to ovate-oblong, rounded or retuse at the apex, not mucronate.

Distribution: southern Russia to central China.

Specimens examined:

RUSSIA: "Rossia meridionalis," date lacking, *Bongard* (G).

AFGHANISTAN: exact locality lacking, 1884–85, *Aitchison 115* (G).

1b. Trachomitum venetum (L.) Woodson var. **microphyllum** (Bég. & Bel.) Woodson, n. comb.

Apocynum venetum L. var. *microphyllum* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 76. 1913.

Leaves ovate-oblong to oblong-lanceolate, 1–1.5 cm. long, mucronate.

Distribution: east-central China.

Specimens examined:

CHINA: Chin Yuan Hsien, Shansi, Aug. 10, 1925, *Ling 9582* (US).

2. **Trachomitum sarmatiense**[100] Woodson, n. sp.

Stems erect or ascending, 8–12 dm. tall, glabrous, freely branched; branches subalternate, ascending; leaves opposite, petiolate, oblong-ovate, obtuse or rounded at the apex, truncate to subtruncate at the base, glabrous and more or less glaucous beneath, irregularly and remotely denticulate, membranaceous, mucronate; inflorescence very loose and extensive, bracts inconspicuous, deciduous, never semifoliaceous; corolla cylindrical, the tube 2.5–3.5 mm. long, 2–3.5 mm. broad, not dilating, the lobes .75–1.0 mm. long, ovate-oblong, erect, not spreading; calyx-lobes hispidulous, ovate-deltoid, .75–1.0 mm. long; follicles unknown.

Distribution: known only from southeastern Russia.

Specimens examined:

Russia: "E. Rossia meridion," date lacking, *Herb. Acad. Petrop.* (G).

Summarized, the relationship of the genus *Trachomitum* to the other genera of the subfamily Apocynaceae may be expressed as follows:

Apocynum	Trachomitum	Poacynum
Genus of North America.	*Genus* of Eurasia.	*Genus* of Eurasia.
Inflorescence a trichasium, terminal or axillary.	*Inflorescence* a monochasium, terminal; pedicels solitary.	*Inflorescence* a monochasium, terminal; pedicels paired.
Corolla campanulate to cylindrical, glabrous.	*Corolla* cylindrical to cylindrical-campanulate, granulo-papillate without.	*Corolla* pelviform, granulo-papillate without.
Corollar appendages distinct.	*Corollar appendages* coalesced into a broad ring, apices short.	*Corollar appendages* coalesced into a shallow ring, apices elongate.
Anther auricles parallel	*Anther auricles* convergent.	*Anther auricles* overlapping.

[100] **Trachomitum sarmatiense** Woodson, sp. nov., perenne; caule erecto vel ascendente ramoso striato omino glabro; foliis oppositis petiolatis membranaceis oblongo-ovatis remote irregularisque coriaceo-denticulatis mucronatis; petiolis 3–5 mm. longis; calycis lobis hispidulis ovatis ca. 1 mm. longis; corolla cylindrica granulato-puberulenta, tubo ca. 3 mm. longo, limbo 5-partito, ca. 3. mm. lato; folliculis ignotis.—Type collected in "E. Rossia meridion.," date lacking, collector unknown (G, distributed from *Herb. Acad. Petrop.*).

Stigmata blunt.	*Stigmata* blunt.	*Stigmata* apiculate.
Nectaries distinct.	*Nectaries* distinct.	*Nectaries* more or less coalesced into a ring.
Receptacle totally immersed, entire.	*Receptacle* somewhat elevated above the orifice of the calyx-tube, somewhat lobed.	*Receptacle* somewhat elevated above the orifice of the calyx-tube, entire.
Calyx-tube adnate to the receptacle.	*Calyx-tube* adherent, but not adnate, to the receptacle.	*Calyx-tube* adnate to the receptacle.
Leaves opposite, the margins entire.	*Leaves* opposite, the margins denticulate.	*Leaves* alternate, the margins denticulate.
Petioles subtended by attenuate gland-like appendages.	*Petioles* subtended by attenuate gland-like appendages.	*Petioles* unappendaged or subtended by a pair of punctate glands.

As summarized on pages 162–163, it is considered that evolution in the tribe Apocynaceae has probably progressed from a primitive condition represented by *Apocynum*, through a condition represented at present by *Trachomitum*, to the relatively advanced condition of the genus *Poacynum*. This attitude is taken from a consideration of the inflorescence, the corolline appendages, the nectaries, the receptacle, and the petiolar appendages, as indicated on pages 162–163. The geographical distribution of the three genera would further substantiate such a viewpoint, since the genus *Apocynum* occupies geologically older territory than the genera *Trachomitum* aznd *Poacynum*, which are almost entirely restricted to the Tertiary sea troughs of southern Europe and south-central Asia.

ABBREVIATIONS

In the preceding taxonomic treatment of the genus *Trachomitum*, the various herbaria in which specimens have been examined are noted as follows:

MBG = Herbarium of the Missouri Botanical Garden.
G = Gray Herbarium of Harvard University.
NY = Herbarium of the New York Botanical Garden.
US = United States National Herbarium.
F = Herbarium of the Field Museum of Natural History.
ANSP = Herbarium of the Academy of Natural Sciences of Philadelphia.

LIST OF EXSICCATAE

The distribution numbers are printed in *italics*. Unnumbered collections are indicated by a dash. The numbers in parentheses are the species numbers used in this monograph.

Aitchison, J. E. T. *115* (1a).
Ascherson, P. — (1).
Ball, J. — (1).
Bernhardi Herb. — (1).
Bongard, G. H. — (1a).
Burkhardt, —. — (1).
Burmeister, —. — (1).
David, A. — (1).
Engelhardt, V. — (1).
Fiori, A. & Béguinot, A. *1109* (1).
Fischer, —. *84* (1).
Gandoger, M. *1661* (1).
Grout, Dr. —. & Hemsdall, Rev. —. — (1).
Herb. Acad. Petrop. — (1); — (2).
Hohenacker, R. F. —, *397* (1).
Kammerer, P. — (1).
Karelin, —. & Kiriloff, —. — (1).
Kettner, —. — (1).
Lagger, —. — (1).
Ling, K. *9114* (1); *9582* (1b).
Martens, F. W. — (1).
Nervessky, —. — (1).
Pease, A. S. *9213* (1).
Penzig, O. *1169* (1).
Perry, W. — (1).
Pichler, —. *188* (1).
Prihler, Th. — (1).
Regel, A. — (1).
Schrenk, —. — (1).
Timsfegen, —. — (1).
Vaccari, A. — (1).
Wiedemann, —. — (1).

IV. A Revision of the Genus Poacynum

The genus *Poacynum* was segregated from *Apocynum* by Baillon[101] in 1888, who based it upon *Apocynum pictum* Schrenk. The only distinctive characters which were recorded by Baillon were the alternate leaves and the pelviform corolla, hence the genus has been widely misunderstood.

Baillon[102] remained convinced of the validity of his genus *Poacynum* in subsequent works, as was also Schumann,[103] who organized the Apocynaceae for Engler & Prantl's 'Die natürlichen Pflanzenfamilien.' However, Danguy,[104] and Béguinot and Belosersky[105] are of a different opinion, and consider *Poacynum* as representing merely an element of the Linnaean genus *Apocynum*. Danguy, while considering *Poacynum* as congeneric with *Apocynum*, recognized that the former genus differs from the latter by

[101] Baill. Bull. Soc. Linn. Paris **1**: 757. 1888.
[102] Ibid. Hist. Pl. **10**: 208. 1891.
[103] K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 179. 1895.
[104] P. Danguy in Lecomte, Not. Syst. **2**: 135. 1911.
[105] Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 77. 1913.

such important characters as the alternate leaves, the pelviform corolla, and an annular "disc," thus representing a most unusual element in the latter genus. Béguinot and Belosersky, however, reduced *Poacynum* to a section, *Picti*, of *Apocynum*, with the following diagnosis:[106] ". . sparse foliage, gradually attenuate to a point, coriaceous, of a glaucous greenish color, with nerves more or less visible, . . pelviform corolla, and . . pendulous flowers."

Several morphological reasons (cf. pp. 162–163) have already been given in a previous section of this study in an attempt to justify the retention of *Poacynum* as a genus of the subfamily Apocynoideae.

For a personal knowledge of the genus *Poacynum*, which is extremely rare in continental herbaria, and which was entirely absent from American collections until the present studies were undertaken, the author is indebted to M. P. Danguy of the Herbarium of the Museum of Paris for fragments of the type specimen of *P. grandiflorum* Danguy, to Mr. Alfred Rehder of the Arnold Arboretum of Harvard University for a fragment of the type specimen of *Apocynum Hendersonii* and a photograph of *Poacynum pictum* (Schrenk) Baill. which he obtained from the Jardin Principal Botanique de Petrograd through the kindness of Prof. Boris Fedtschenko, and to Dr. Carl C. Epling for a fragment of an authentic specimen of *Apocynum Hendersonii.*

Poacynum Baill. Bull. Soc. Linn. Paris **1**: 757. 1888; Hist. Pl. **11**: 208. 1891; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[1]: 179. 1895.

Apocynum § *Picti* Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 77. 1913.

Herbaceous lactescent perennials from a somewhat thickened fibrous rhizome. Stems erect or ascending, terete, striate, glabrous; branches ascending, alternate to subalternate; leaves

[106] Bég. & Bel. Atti R. Accad. Lincei, V. 9: 77. 1913. "Comprende [Stirps A. Picti] due specie confinate nell' Asia centrale: e, cioe, *A. pictum* della Songaria, ed *A. Hendersonii*, pure di questo paese, non che del Turkestan cinese e del Kan-sou mongolico. Ambedue convengono per alcuni caratteri di stirpe, quali le foglie sparse, insensibilmente attenuate in picciuolo, coriacee, di un colore verde-glauco, con nervi poco o punto visibili, per la corolla piu grande, pelviforme e per i fiori penduli."

alternate, petiolate, oblong to lanceolate, membranaceous, remotely denticulate along the margin, and frequently also along the midrib of the lower surface, mucronate, or without a mucro, penninerved; petioles subtended by two punctate glands or eglandular. Inflorescence a terminal monochasium, bearing paired pedicels. Calyx regularly 5-parted, hispidulous, the tube adnate to the receptacle, eglandular within. Corolla pelviform, regularly 5-parted, conspicuously granulo-papillate without, bearing within 5 elongate-apiculate appendages coalesced into a shallow ring adnate to the base of the tube, the apices opposite the lobes of the corolla; limb widely spreading, dextrorsely convolute in the bud. Stamens 5, alternate with the apices of the appendicular ring and attached to the base of the corolla-tube, anthers appendaged, convergent about the pistil; filaments short, flattened; pollen borne in tetrads, mostly sterile. Carpels 2, unilocular, sessile, united at the apices by an ovate-cylindrical clavuncle bearing the terminal binate apiculate stigma; ovules many, anatropous, borne upon a ventral, lateral placenta. Receptacle somewhat elevated above the orifice of the calyx-tube, entire; nectaries 5, more or less coalesced into a ring about the gynoecium. Follicles terete, pendulous, 15–30 cm. long, divaricate or somewhat falcate, containing many dry, apically comose, clavate-terete, exalbuminous seeds; embryo straight.

Type species: *Poacynum pictum* (Schrenk) Baill. Bull. Soc. Linn. Paris **1**: 757. 1888.

KEY TO THE SPECIES

a. Calyx-lobes ovate; leaves linear........................*1. Poacynum pictum*
aa. Calyx-lobes lanceolate; leaves lanceolate to oblong-ovate.
  b. Leaves cuneate-lanceolate, decidedly mucronate; nectaries evident, about ⅔ the length of the carpels..........*2. Poacynum grandiflorum*
  bb. Leaves oblong-lanceolate to oblong-ovate, neither cuneate nor mucronate; nectaries inevident, about ⅓ the length of the carpels...*2. Poacynum Hendersonii*

1. **Poacynum pictum** (Schrenk) Baill. Bull. Soc. Linn. Paris **1**: 757. 1888; Hist. Pl. **10**: 208. 1891; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4^1: 179. 1895.

Apocynum pictum Schrenk, Bull. Acad. St. Petersb. **2**: 115. 1844; Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 77. 1913.

Stems erect or ascending, 5–10 dm. tall, glabrous, freely branched; branches alternate to subalternate, ascending; leaves petiolate or subsessile, linear or very narrowly lanceolate, acute to acuminate at base and apex, membranaceous, glabrous, denticulate, mucronate; inflorescence few-flowered, bracts evident, scarious; corolla pelviform, granulo-papillate, about 1–1.5 cm. broad; calyx-lobes ovate, about 3–5 mm. long, hispidulous; follicles unknown.

Distribution: Songaria.

Specimens examined:

SONGARIA: "in deserto songooro-kirghisico ad m. Tamgaly-Tas," *Schrenk* (L, TYPE, MBG photograph).

2. **Poacynum grandiflorum** P. Danguy in Lecomte, Not. Syst. **2**: 136. 1911.

Apocynum grandiflorum P. Danguy in Lecomte, *l. c.* 137. 1911.

Stems erect or ascending, 5–10 dm. tall, glabrous, freely branched; branches alternate, ascending; leaves petiolate, cuneate-lanceolate, 3–5 cm. long, 1–1.5 cm. broad, remotely denticulate, decidedly mucronate, membranaceous; inflorescence relatively few-flowered; corolla pelviform, 1.5–2 cm. broad, granulo-papillate; calyx-lobes lanceolate, about 2 mm. long, hispidulous; nectaries evident, about two-thirds the length of the carpels; follicles terete, pendulous, 1.5–3 cm. long; seeds clavate, 3–4 mm. long, coma 15–20 mm. long.

Distribution: Turkestan.

Specimens examined:

TURKESTAN: Cha-yar, prov. of Chouchar, May, 1907, *Vaillant 266* (MP TYPE, MBG fragment).

3. **Poacynum Hendersonii** (Hook. f.) Woodson, n. comb.

Apocynum Hendersonii Hook. f. in Henderson & Hume, Lahore to Yarkand, 327. 1878, Bég. & Bel. Atti R. Accad. Lincei, V. **9**: 78. 1913.

Stems erect or ascending, 5–10 dm. tall, glabrous, freely branched; branches alternate, ascending; leaves petiolate, oblong-lanceolate to oblong-ovate, 3–5 cm. long, 1–2 cm. broad, neither cuneate nor mucronate; inflorescence relatively many-flowered;

corolla pelviform, granulo-papillate, 1.5–2 cm. broad; calyx-lobes lanceolate, about 3 mm. long; nectaries inevident, about one-third the length of the carpels; follicles unknown.

Distribution: Turkestan and Songaria.

Specimens examined:

TURKESTAN: Kashgar, alt. 4000 ft., date lacking, *Creswell* (BM, MBG, fragment); Yarkand, sandy desert, alt. 4000 ft., May 20, 1874, *Henderson & Hume* (L, MBG fragment).

ABBREVIATIONS

BM = Herbarium of the British Museum
L = Herbarium of the Jardin Principal de Leningrad
MBG = Herbarium of the Missouri Botanical Garden
MP = Herbarium of the Museum of Paris

V. INDEX TO SPECIES

New genera, species, varieties, and combinations are printed in **bold face** type; synonyms in *italics*; and previously published names in ordinary type.

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Explanation of Plate

PLATE 1

Geographical distribution of the genus *Apocynum*.

A. androsaemifolium.
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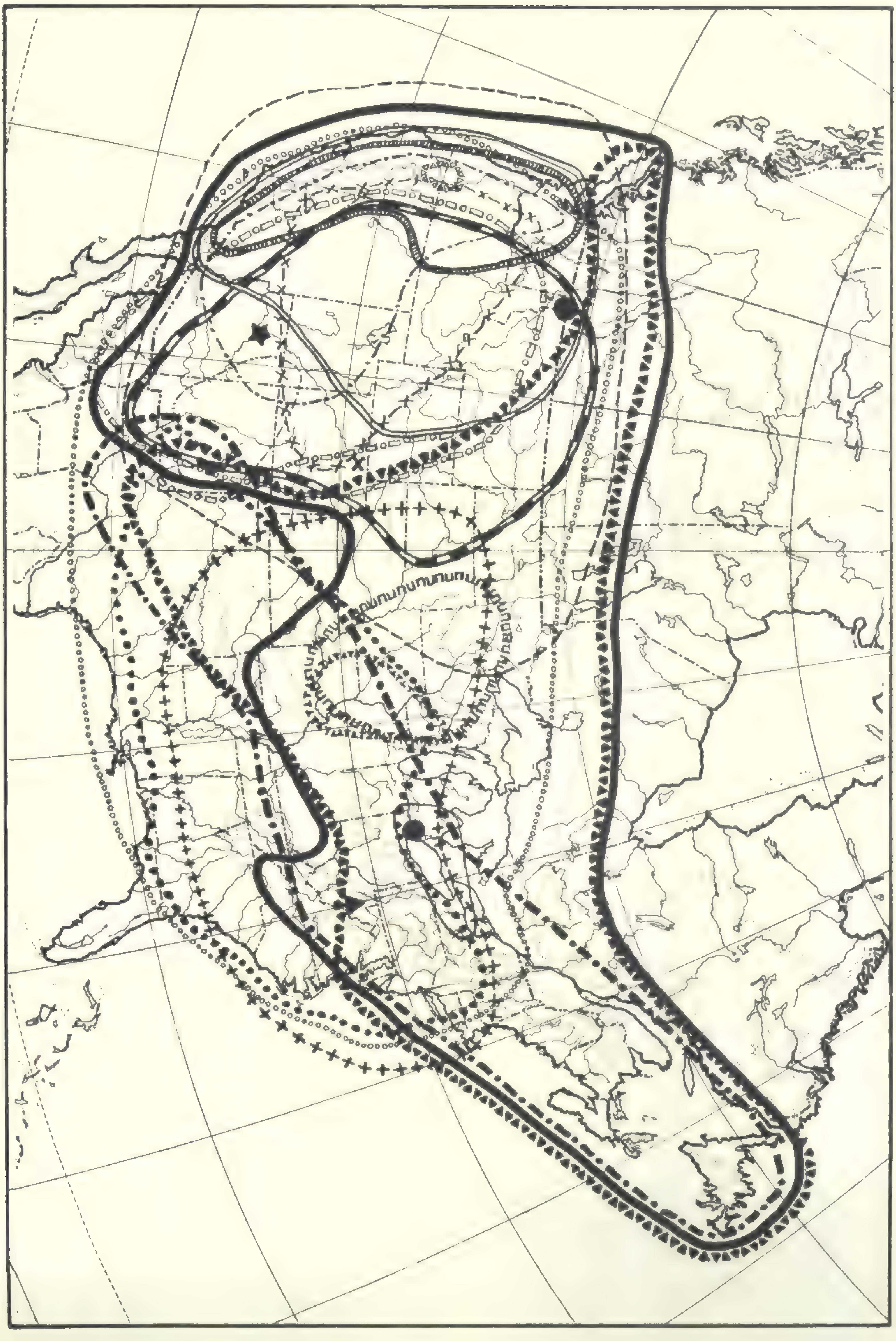
A. androsaemifolium var. *intermedium.*
A. pumilum.
A. pumilum var. *rhomboideum.*
A. medium.
A. medium var. *leuconeuron.*
A. medium var. *floribundum.*
A. medium var. *sarniense.*
A. medium var. *lividum.*
A. medium var. *vestitum.*
A. Jonesii.
A. Suksdorfii.
A. Suksdorfii var. *angustifolium.*
A. cannabinum.
A. cannabinum var. *pubescens.*
A. cannabinum var. *glaberrimum.*
A. cannabinum var. *Greeneanum.*
A. cannabinum var. *hypericifolium.*
A. cannabinum var. *Farwellii.*
A. cannabinum var. *cordigerum.*
A. cannabinum var. *salignum.*



WOODSON—APOCYNACEAE

Explanation of Plate

PLATE 2

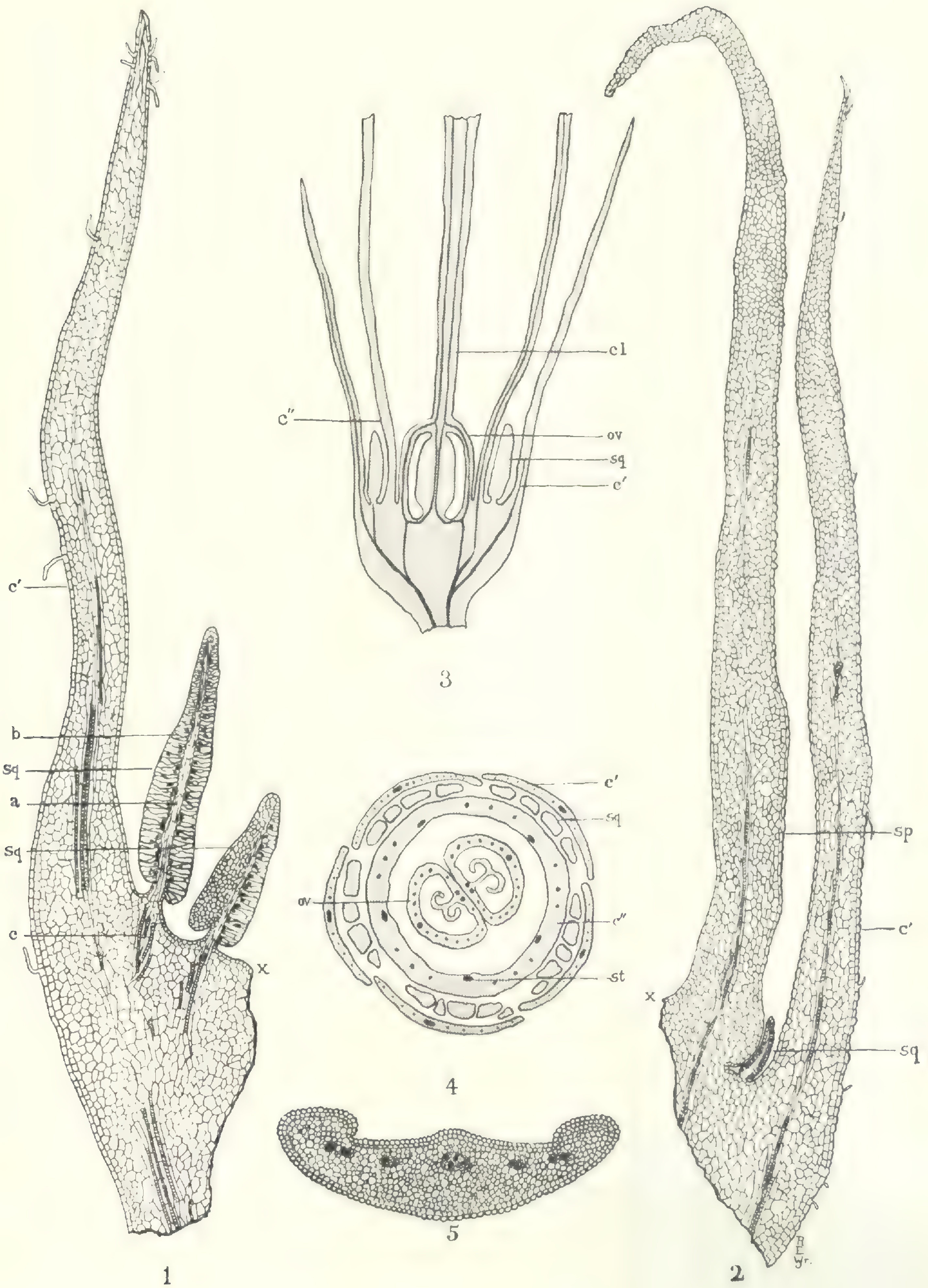
Fig. 1. Longitudinal section of calyx-lobe of single-flowered form of *Nerium Oleander:* *x*, place of attachment to the receptacle; *c′*, calyx-lobe proper; *sq*, calycine squamellae; *b*, peripheral glandular tissue; *a*, central "conductive" tissue; *c*, occasional vascular traces leading to squamellae. × 20.

Fig. 2. Longitudinal section of calyx-lobe and supernumerary petal of double-flowered form of *Nerium Oleander:* *x*, place of attachment to the receptacle; *sp*, supernumerary petal; *c′*, calyx-lobe proper; *sq*, squamella. × 20.

Fig. 3. Diagram of a median longitudinal section of single-flowered form of *Nerium Oleander* illustrating the vascular anatomy: *c′*, calyx; *c″*, corolla; *ov*, ovary; *cl*, clavuncle; *sq*, squamellae.

Fig. 4. Diagram of a cross-section of single-flowered form of *Nerium Oleander:* *c′*, calyx-lobes; *c″*, corolla; *ov*, ovary; *sq*, squamellae; *st*, staminal traces.

Fig. 5. Cross-section of a supernumerary petal of double-flowered form of *Nerium Oleander.* × 20.



WOODSON—APOCYNACEAE

Explanation of Plate

PLATE 3

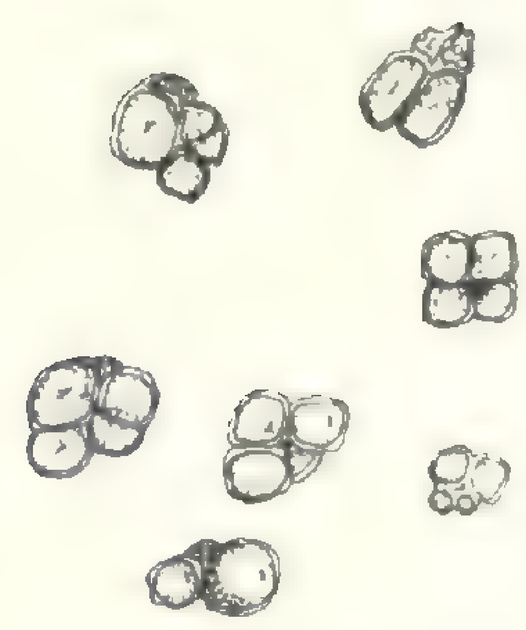
Fig. 1. Diagrammatic longitudinal section of flower of *Apocynum androsaemifolium*, indicating the vascular anatomy: *a*, corolla; *b*, calyx; *c*, ovary; *d*, clavuncle; *e*, stamen; *f*, nectary.

Fig. 2. Diagrammatic cross-section of flower of *Apocynum androsaemifolium* through the region of the gynoecium, indicating the vascular anatomy: *a*, adnate staminal filaments; *b*, dorsal corolline traces, *c*, ventral corolline traces; *d*, ovary; *e*, nectaries.

Fig. 3. Diagrammatic cross-section of flower of *Apocynum androsaemifolium* through the region of the androecium, indicating the vascular anatomy: *a*, ventral corolline traces; *b*, dorsal corolline traces; *c*, anther; *d*, clavuncle.

Fig. 4. Longitudinal section through the place of attachment of the staminal filament to the base of the corolla-tube of *Apocynum androsaemifolium: a*, staminal filament; *b*, corolla; *c*, calyx-lobe; *d*, ovary-wall. × 150.

Fig. 5. Pollen grains of *Apocynum medium* var. *leuconeuron*, illustrating sterility and polyspory.



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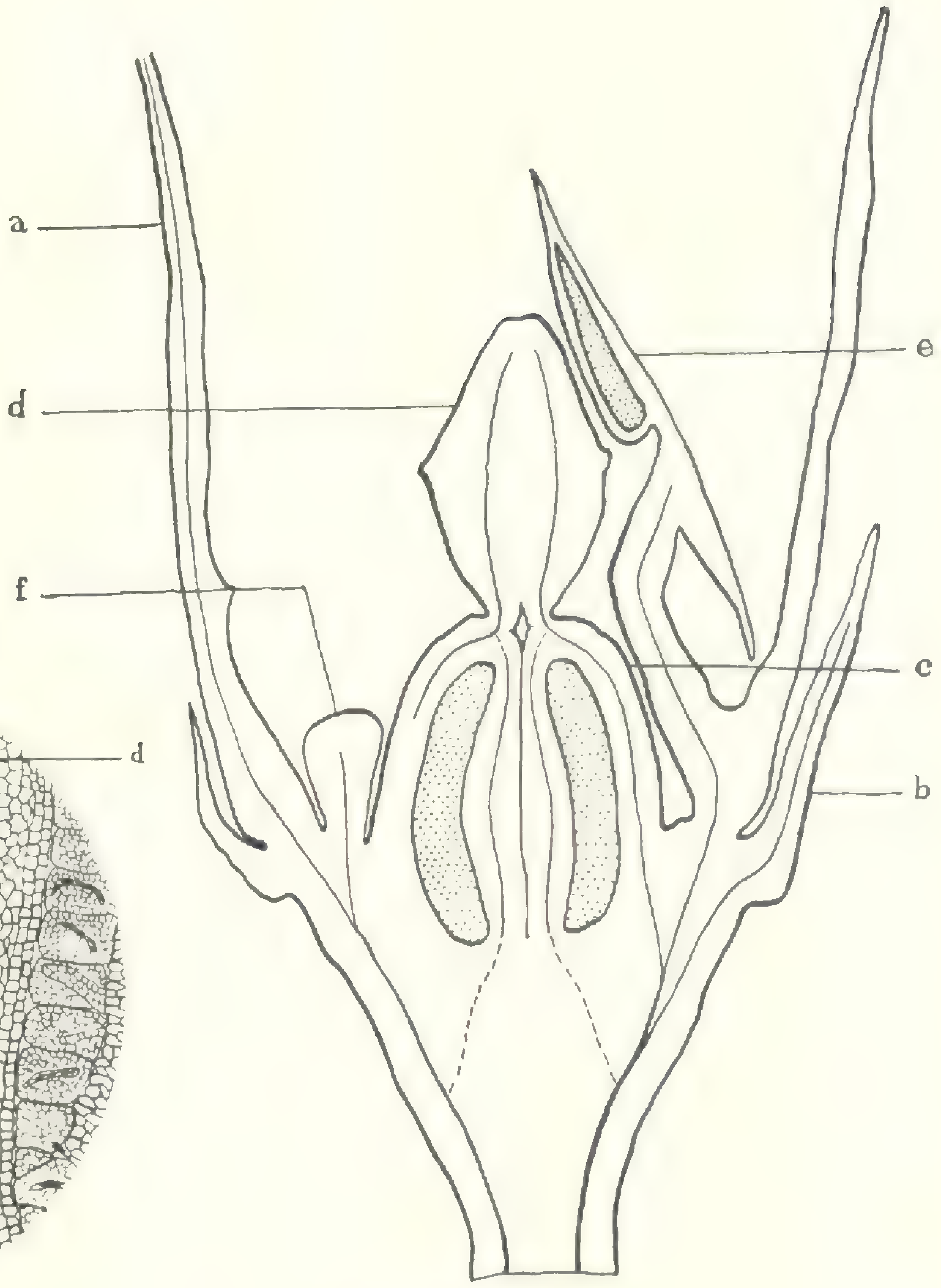

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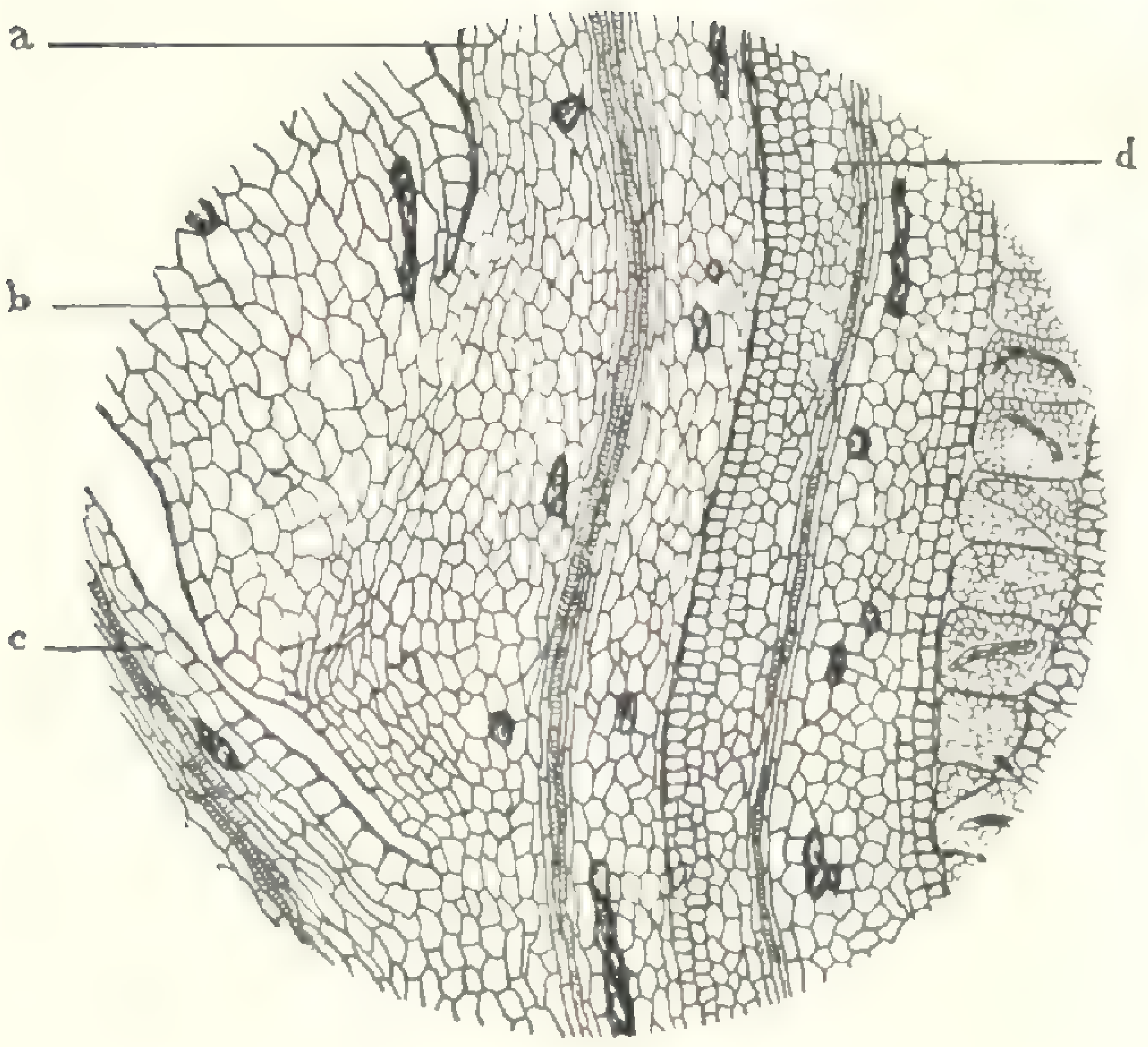

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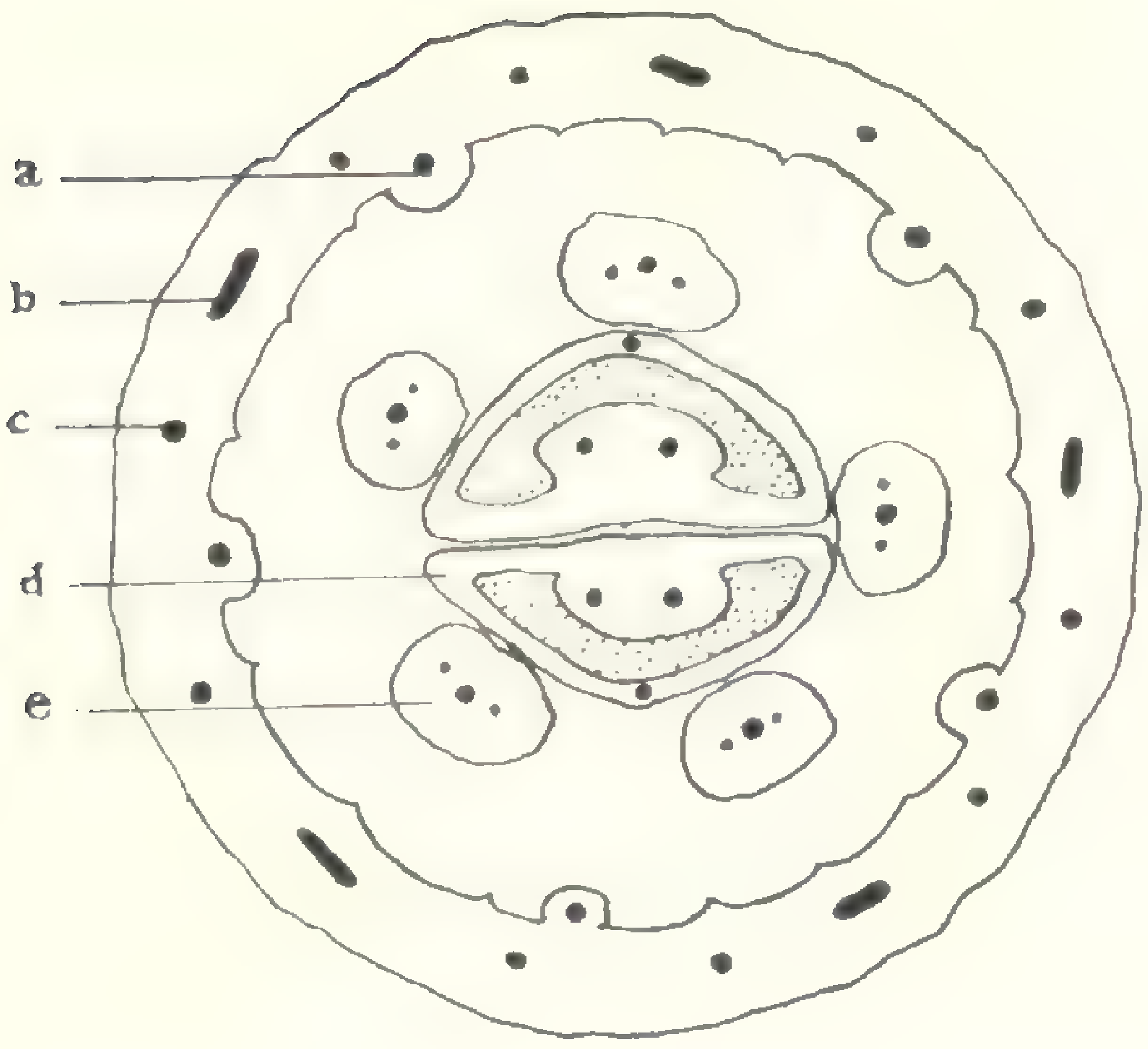

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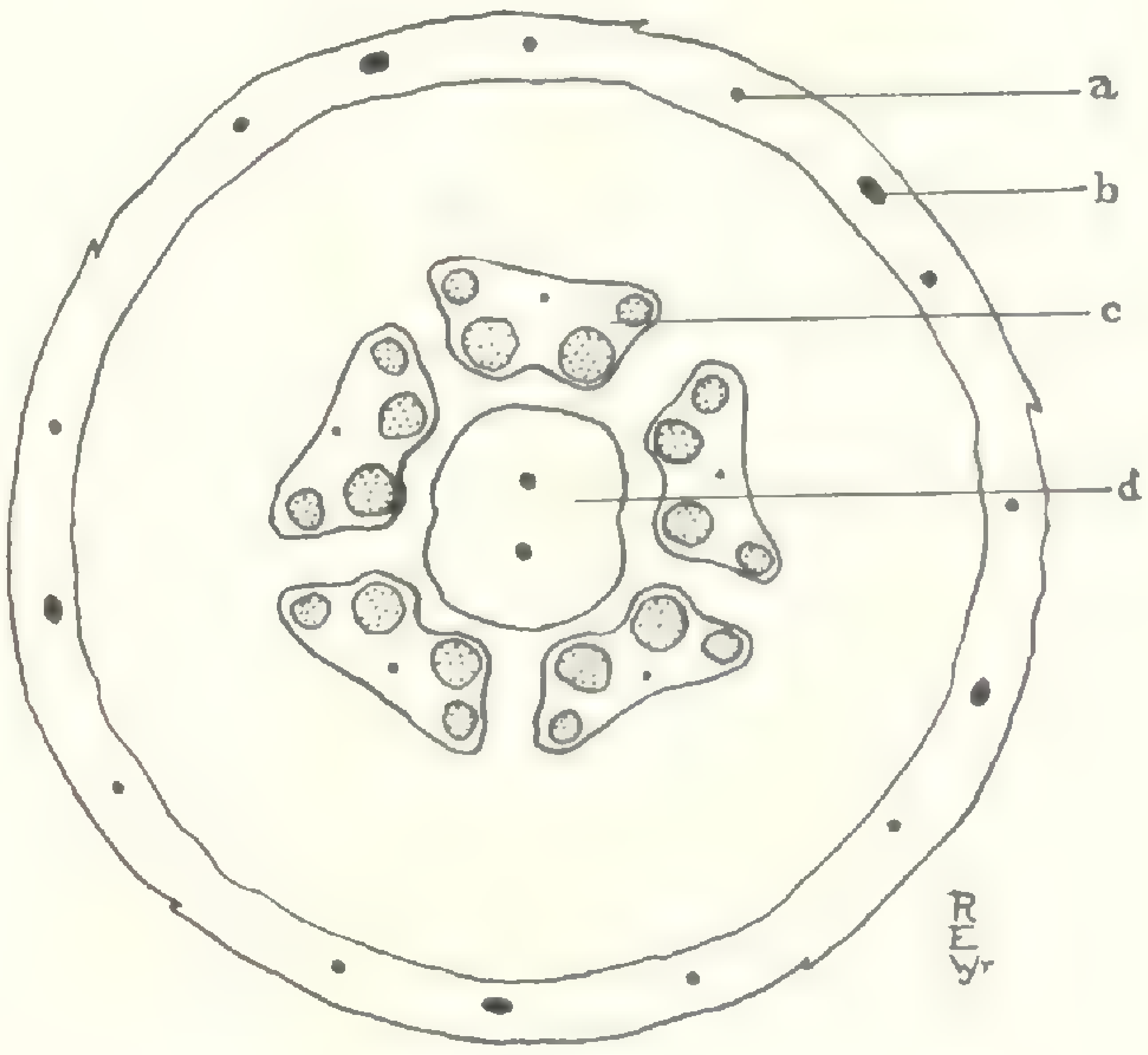

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WOODSON—APOCYNACEAE

Explanation of Plate

PLATE 4

Fig. 1. Cross-section of young root of *Apocynum hypericifolium: a*, epidermis; *b*, cortex; *c*, endodermis; *d*, xylem; *e*, phloem; *f*, pericycle. × 150.

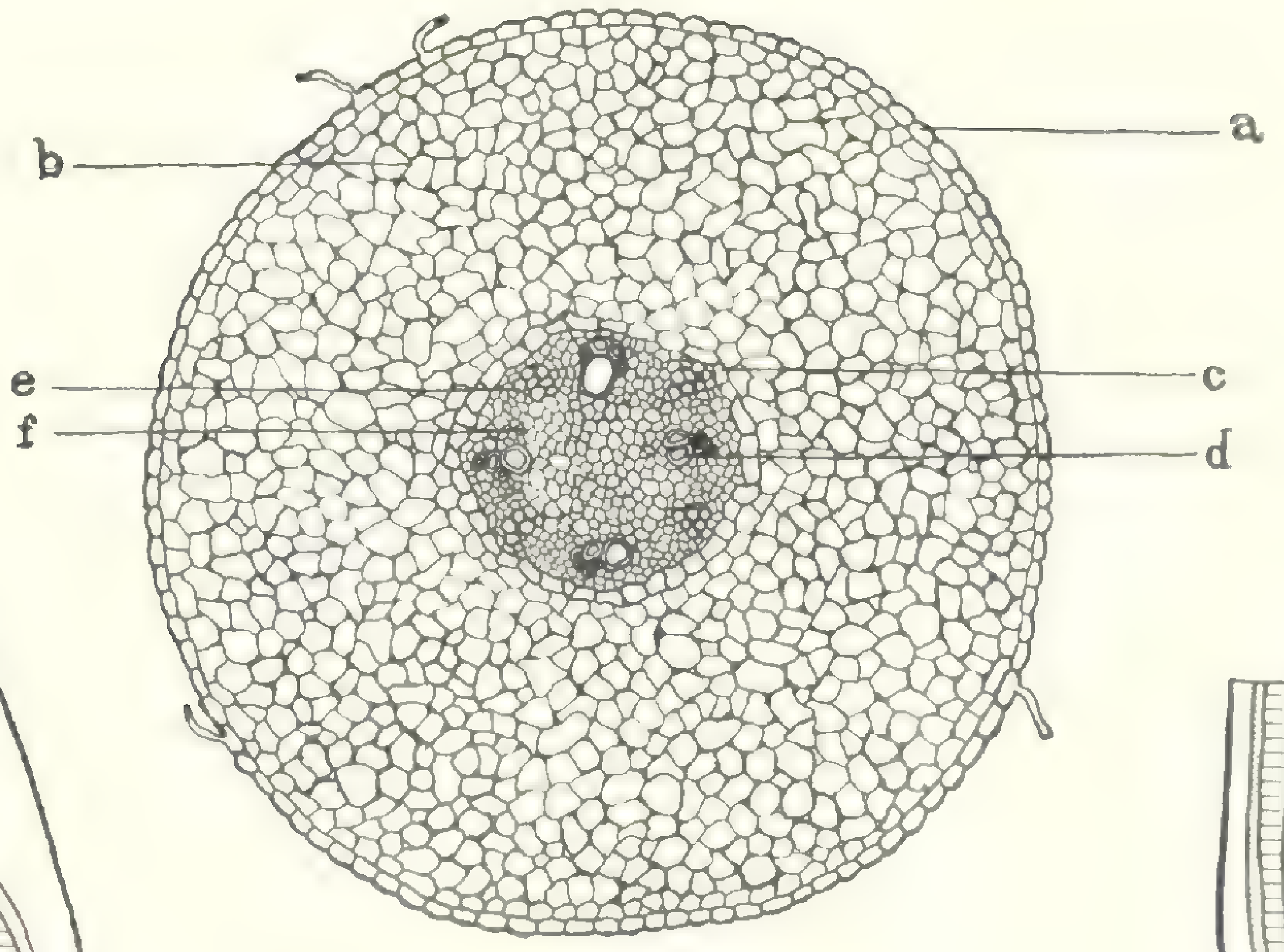
Fig. 2. Cross-section of gemmiferous root of *Apocynum cannabinum* var. *glaberrimum: a*, phellem; *b*, phellogen; *c*, phelloderm; *d*, xylem; *e*, phloem; *f*, cortex; *g*, cambium; *h*, latex tube; *k*, lenticel; *l*, storage ray. × 150.

Fig. 3. Diagrammatic cross-section of node of stem of *Apocynum cannabinum*, immediately below foliar gap.

Fig. 4. Diagrammatic longitudinal section of node of stem of *Apocynum cannabinum.*

Fig. 5. Embryo of *Apocynum hypericifolium.* × 30.

Fig. 6. Tracheid from secondary xylem of stem of *Apocynum cannabinum*, illustrating bordered pits. × 1000.



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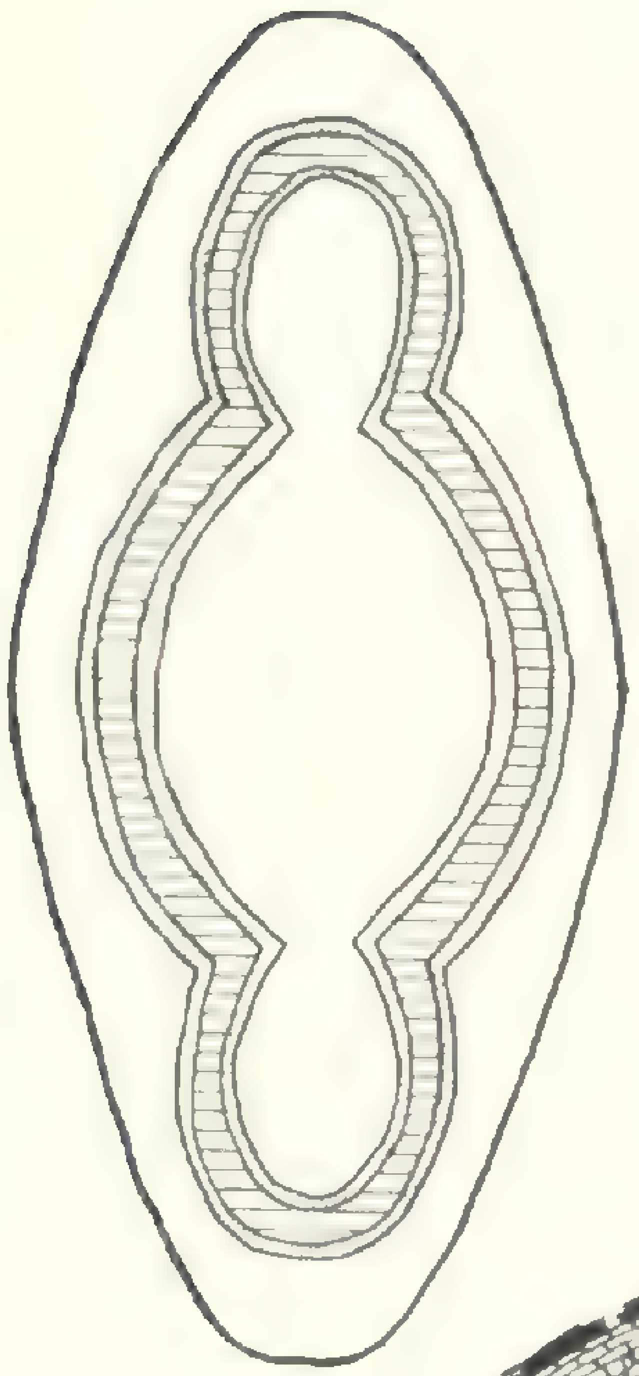

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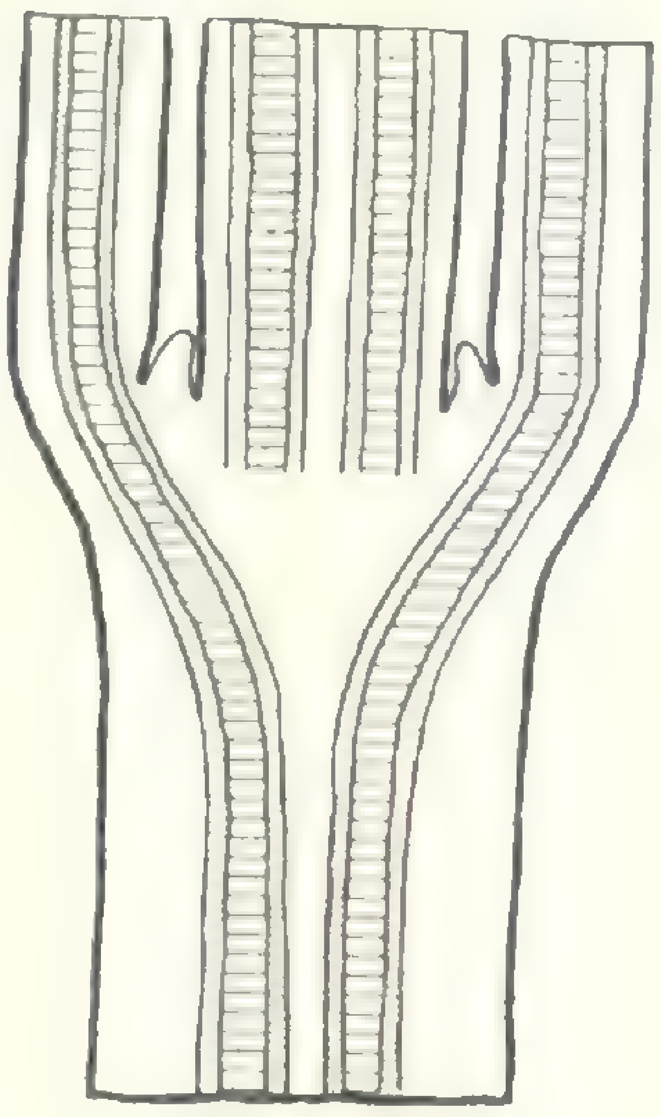

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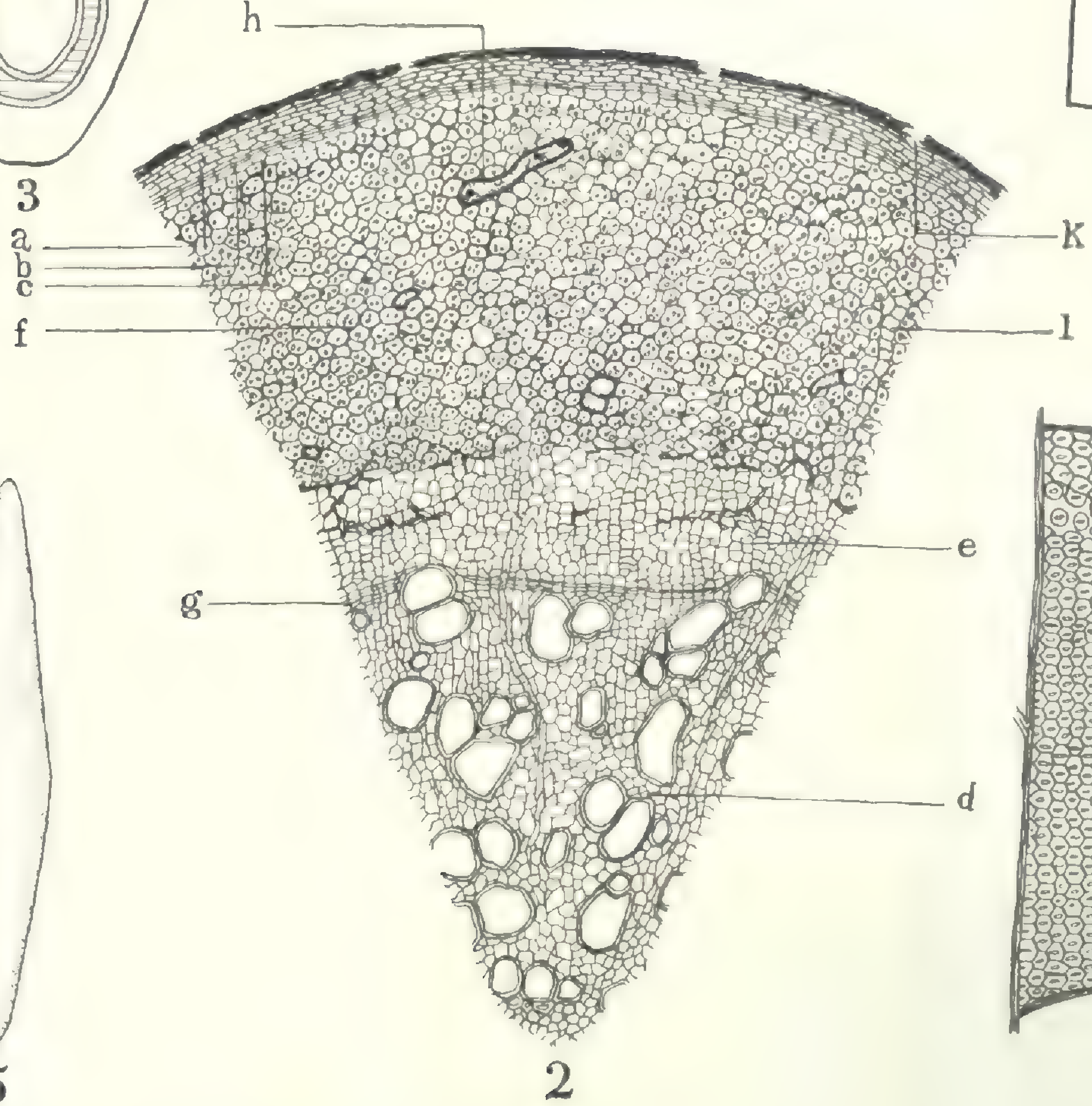

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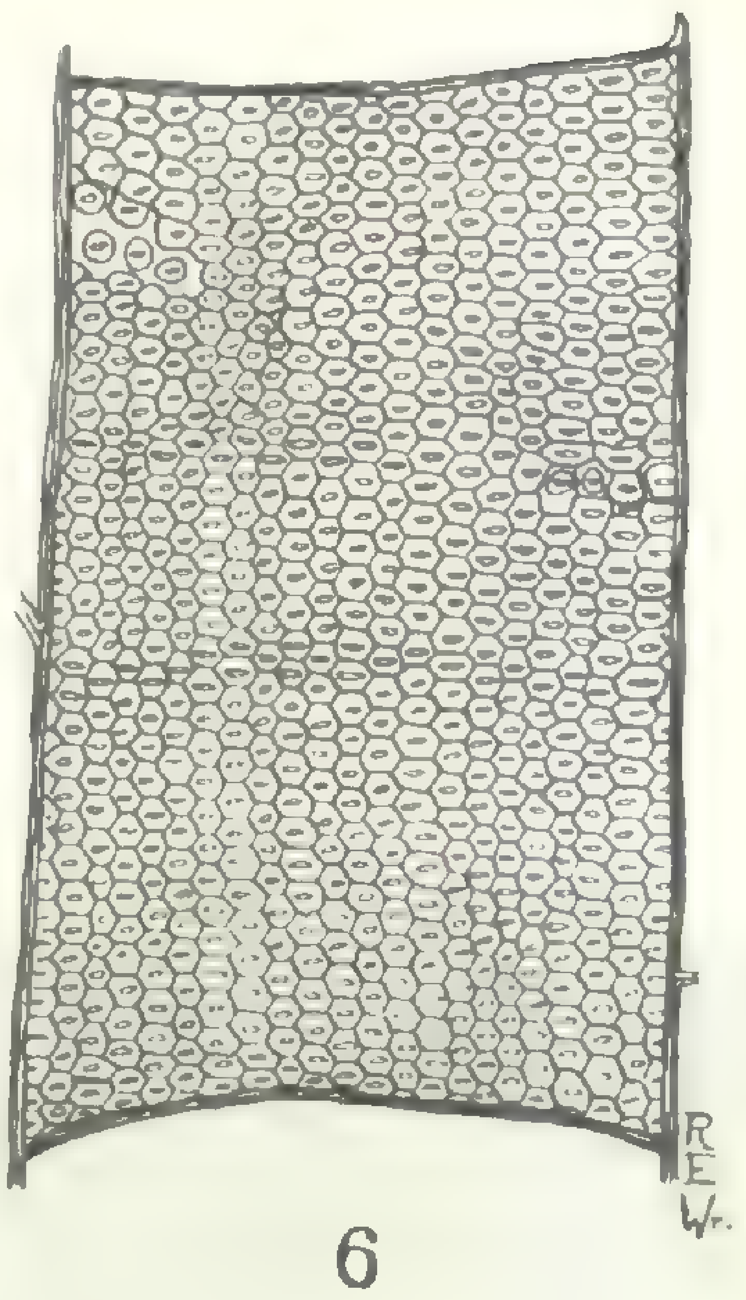

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WOODSON—APOCYNACEAE

Explanation of Plate

PLATE 5

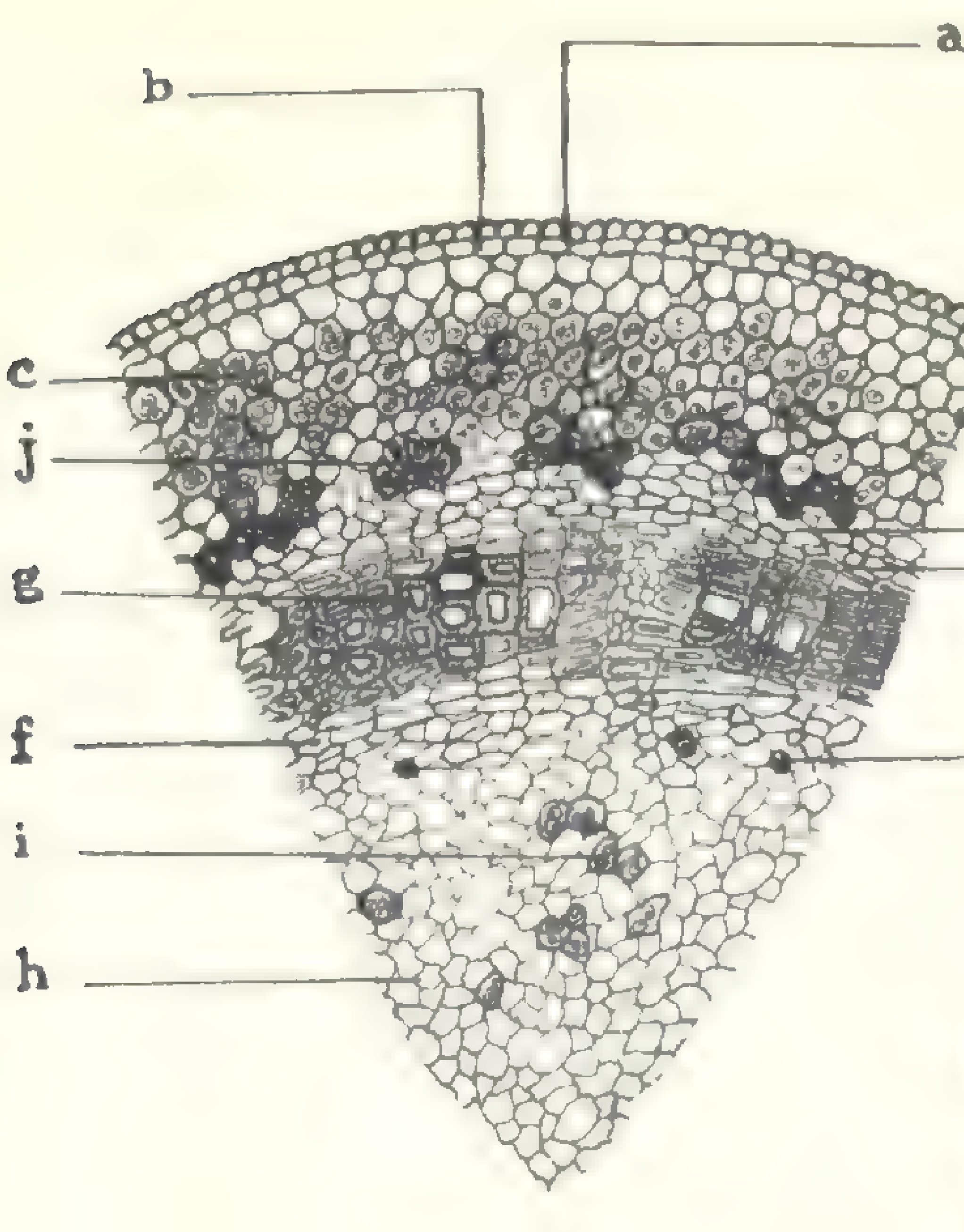
Fig. 1. Sector of a cross-section of a stem of *Apocynum cannabinum: a,* epidermis; *b,* hypodermis; *c,* cortex; *d,* external phloem; *e,* cambium; *f,* internal phloem; g, xylem; *h,* pith; *i,* starch-containing cells of pith; *j,* pericyclic fibers associated with latex tubes; *m,* latex tubes in pith. × 150.

Fig. 2. Sector of a cross-section of a stem of *Apocynum androsaemifolium: a,* dead epidermal cells; *b,* periderm; *c,* cortex; *d,* external phloem; *e,* cambium; *f,* internal phloem; *g,* xylem; *h,* pith; *j,* pericyclic fibers associated with latex tubes; *m,* internal latex tubes. × 150.

Fig. 3. Sector of a cross-section of a fully mature rhizome of *Apocynum cannabinum: a,* dead epidermal cells; *b,* periderm; *c,* cortex; *d,* external phloem; *e,* cambium; *f,* internal phloem; *g,* xylem; *h,* pith; *j,* pericyclic fibers associated with latex tubes; *k,* vascular ray. × 150.

Fig. 4. Habit of the subterranean axes of *Apocynum cannabinum: a,* rhizome; *b,* cataphylls; *c,* young root-shoot enveloped in cataphylls; *d,* young gemmiferous root bearing a young root-shoot; *e,* fully mature gemmiferous root bearing several rhizomes; *f,* strictly absorptive root. × ⅔.

Fig. 5. Starch grains from cortical cells of *Apocynum cannabinum.*



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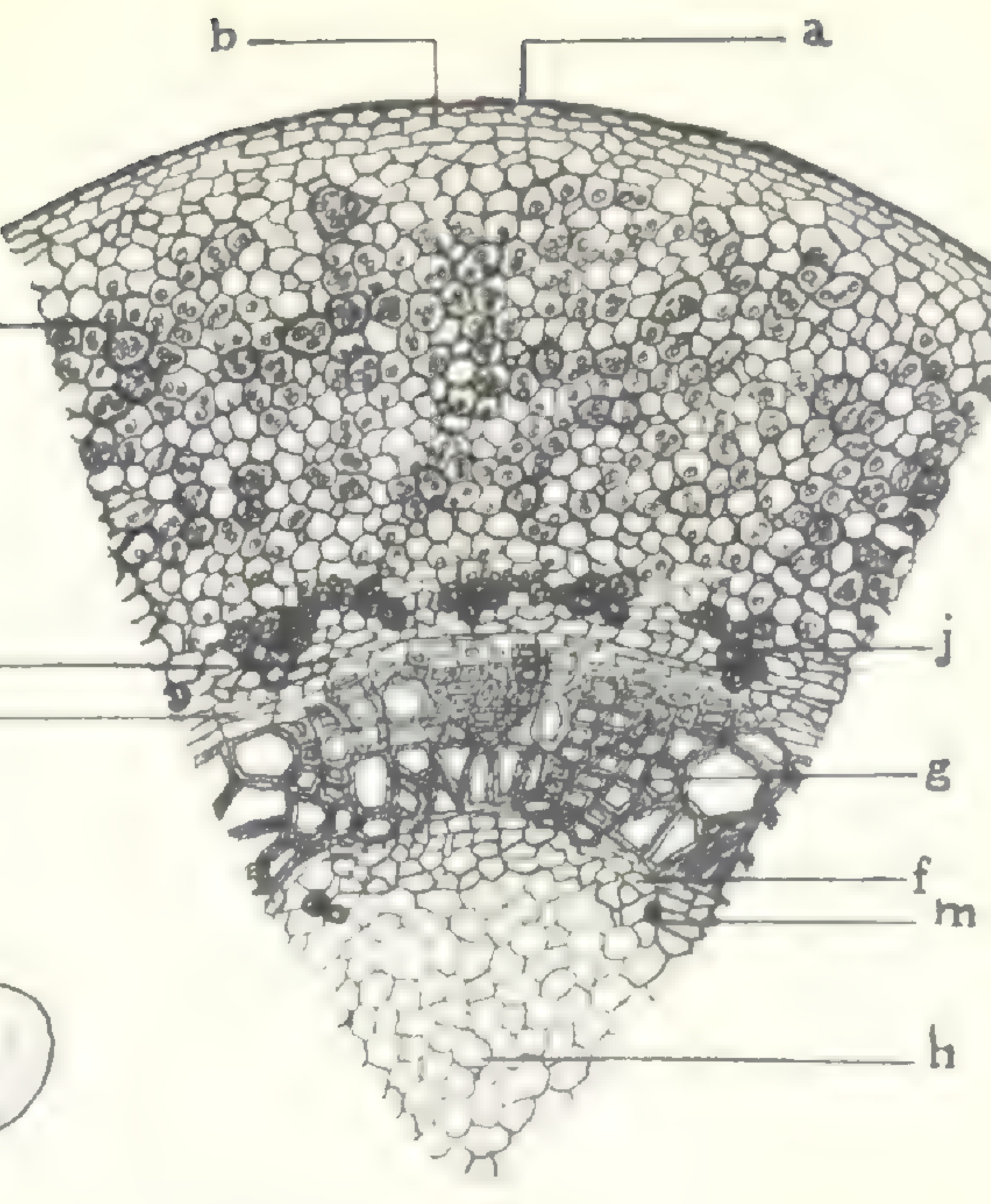

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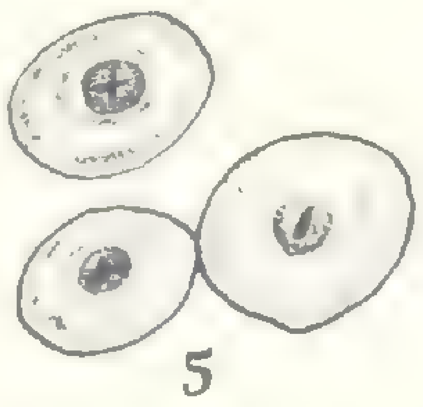

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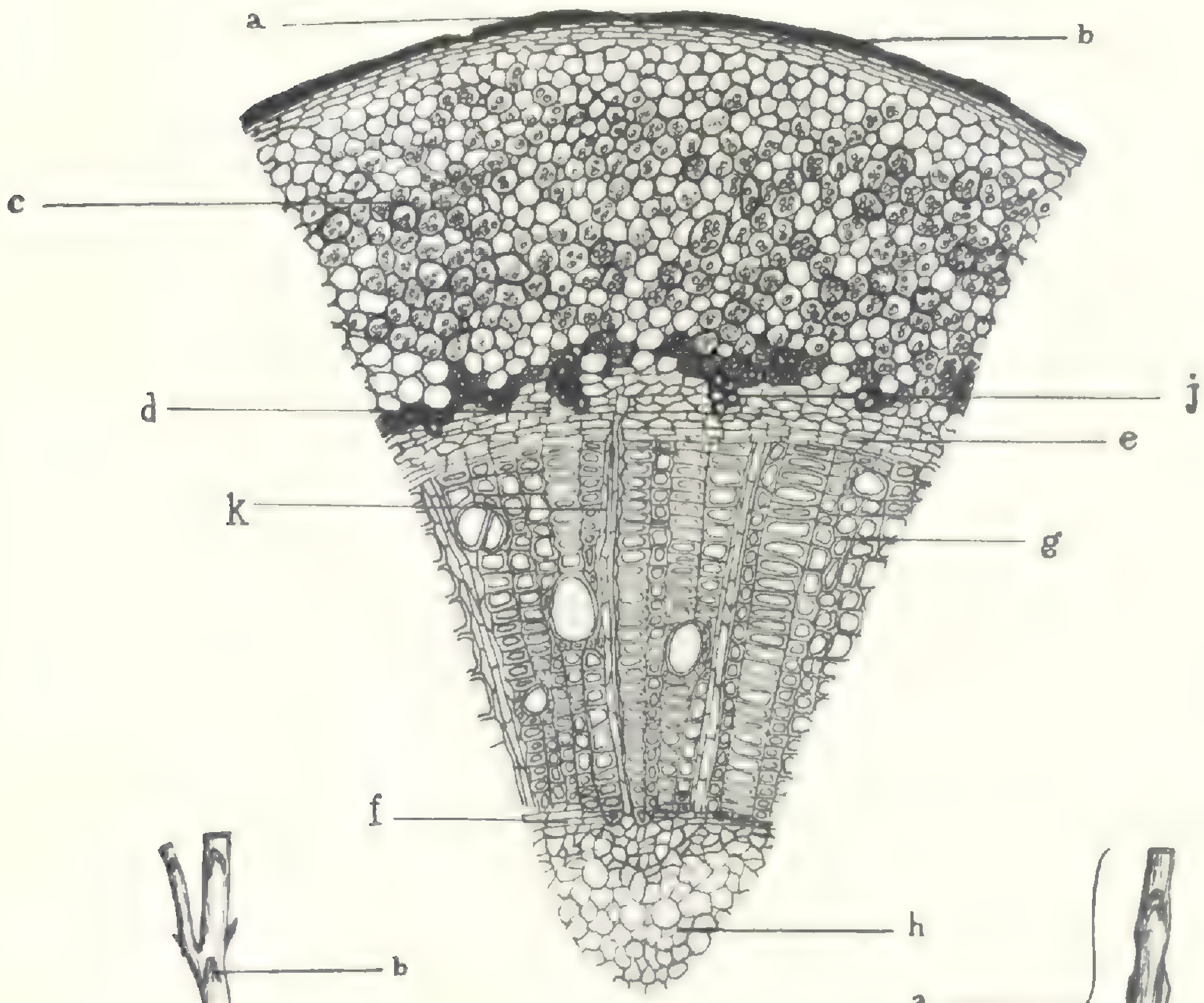

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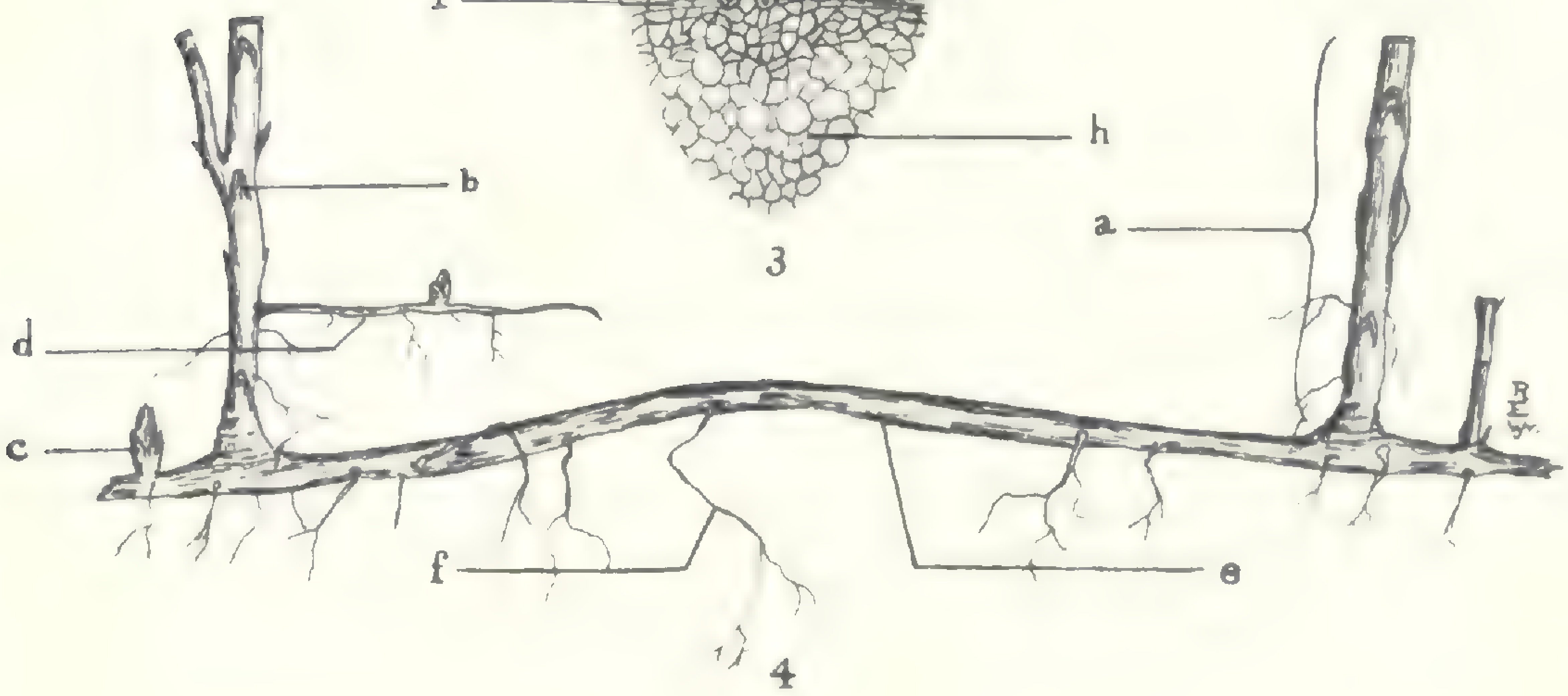

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WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 6

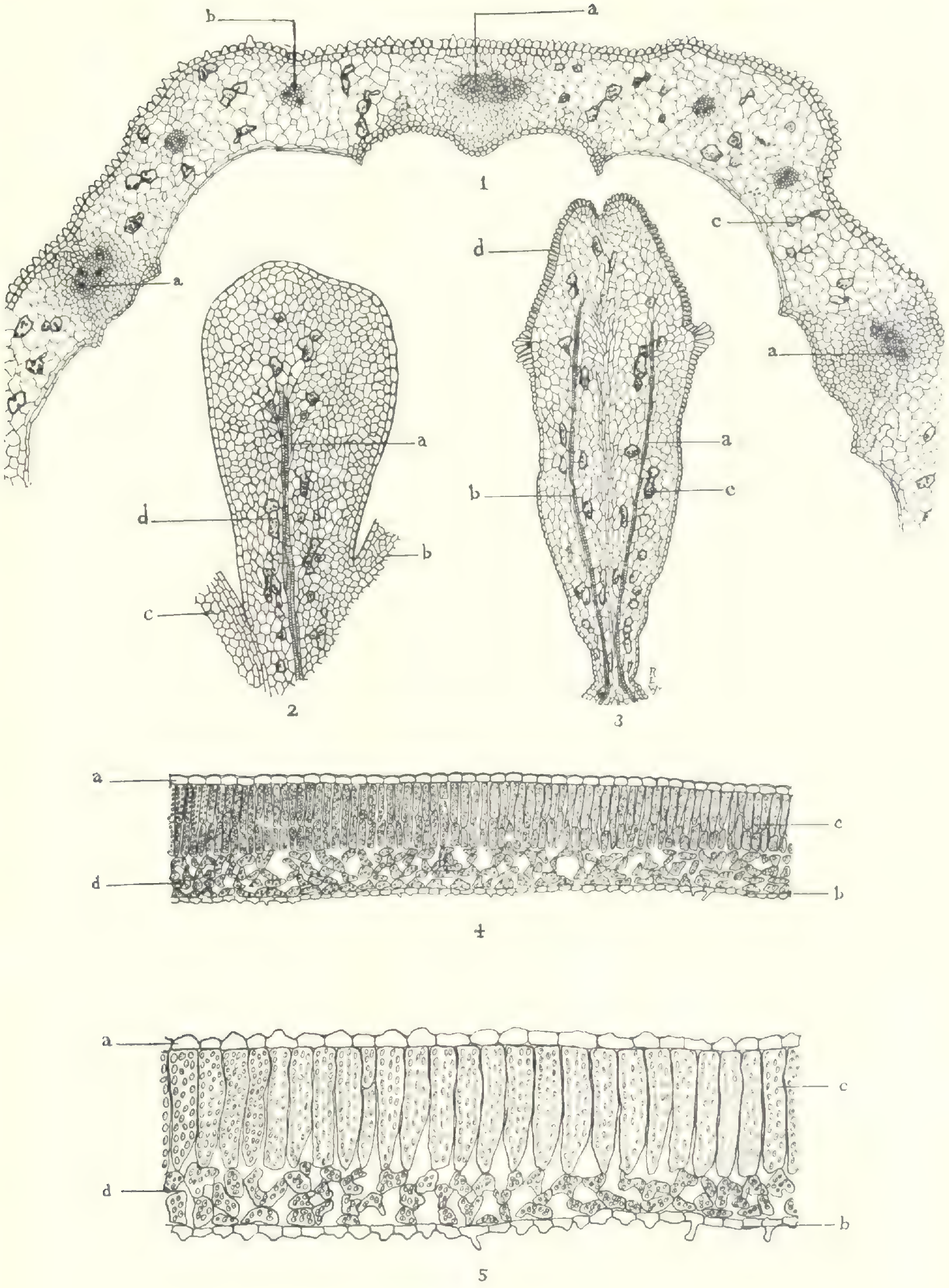
Fig. 1. Sector of a cross-section of the corolla-tube of *Apocynum androsaemifolium* var. *incanum* through the region of the corollar appendages: *a*, dorsal vascular trace; *b*, ventral trace; *c*, latex tubes. × 150.

Fig. 2. Longitudinal section of a nectary of *Apocynum androsaemifolium* var. *incanum*, indicating the vascular anatomy: *a*, dorsal vascular trace of nectary; *b*, sector of corolla-tube; *c*, sector of ovary wall; *d*, latex tubes. × 150.

Fig. 3. Longitudinal section of the clavuncle of *Apocynum androsaemifolium*, indicating the vascular anatomy: *a–b*, continuation of the dorsal vascular trace of either carpel of the gynoecium; *c*, latex tubes; *d*, glandular cells of the stigmatic surface. × 150.

Fig. 4. Cross-section of a leaf of *Apocynum cannabinum* var. *glaberrimum: a*, upper epidermis; *b*, lower epidermis; *c*, palisade parenchyma; *d*, spongy parenchyma. × 100.

Fig. 5. Cross-section of a leaf of *Apocynum androsaemifolium* var. *incanum:* a, upper epidermis; *b*, lower epidermis; *c*, palisade parenchyma; *d*, spongy parenchyma. × 150.

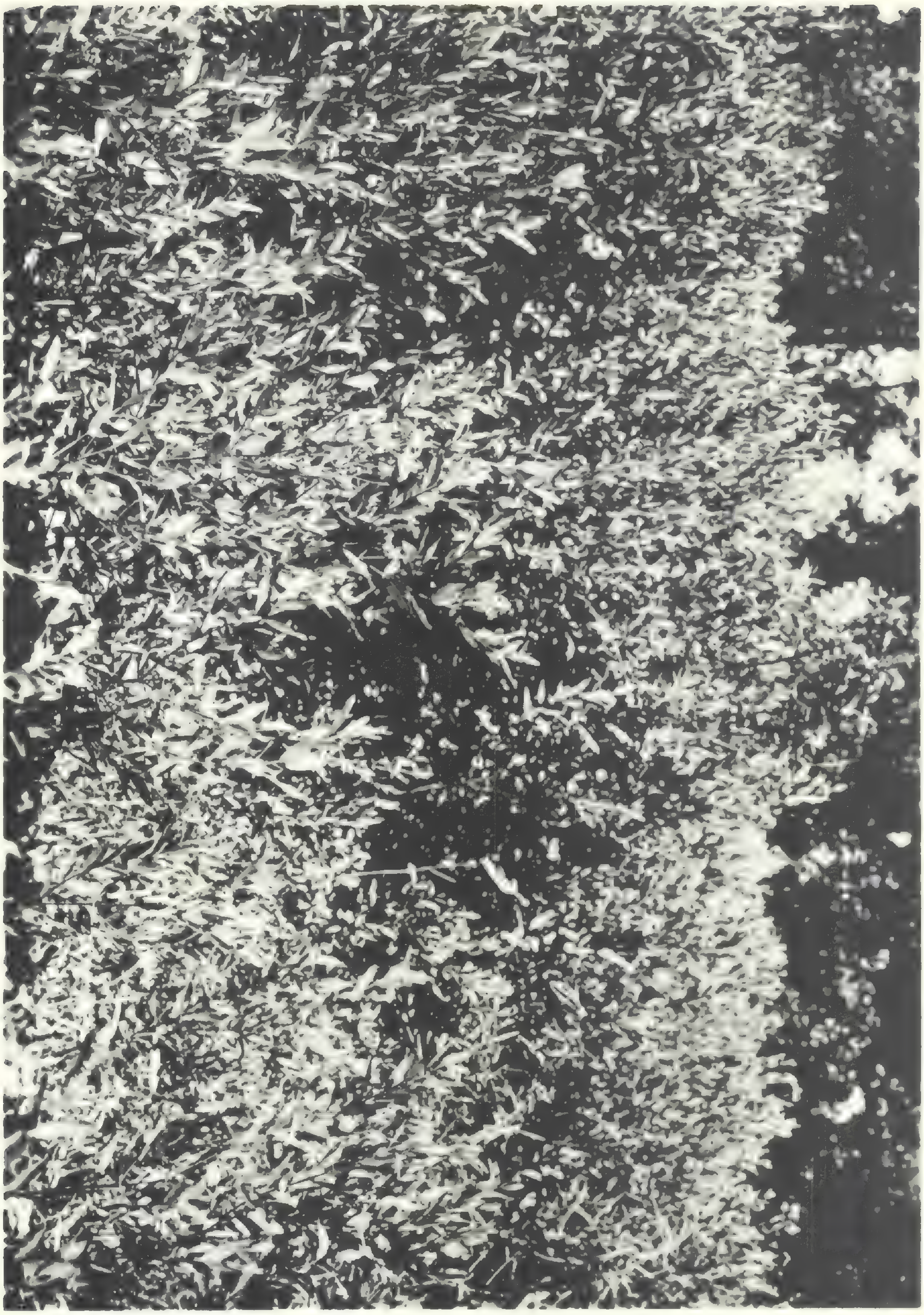


WOODSON—APOCYNACEAE

Explanation of Plate

PLATE 7

A typical clone of *Apocynum cannabinum*, near Carondelet, Missouri.



WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 8

Apocynum medium var. *lividum*, infesting cultivated field, near Bayfield, Colorado.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 9

Habit of *Apocynum androsaemifolium* L. var. *incanum* A. DC. × ½; enlarged flower, × 2.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 10

Habit of *Apocynum pumilum* (A. Gray) Greene var. *rhomboideum* (Greene) Bég. & Bel. × ½; enlarged flower, × 2.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 11

Habit of *Apocynum medium* Greene, × ½; enlarged flower, × 2.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 12

Habit of *Apocynum medium* Greene var. *floribundum* (Greene) Woodson, × ½; enlarged flower, × 3.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 13

Habit of *Apocynum medium* Greene var. *vestitum* (Greene) Woodson, × ½; enlarged flower, × 3.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 14

Habit of *Apocynum Jonesii* Woodson, × ½; enlarged flower, × 4.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 15

Habit of *Apocynum Suksdorfii* Greene, × ½; enlarged flower, × 4.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 16

Habit of *Apocynum cannabinum* L. × ½; enlarged flower, × 4.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 17

Habit of *Apocynum cannabinum* L. var. *Greeneanum* (Bég. & Bel.) Woodson, × ½; enlarged flower, × 3.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 18

Habit of *Apocynum hypericifolium* Ait. × ½; enlarged flower, × 3.

del. J. A. Steyermark.

WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 19

Habit of *Apocynum hypericifolium* Ait. var. *salignum* (Greene) Woodson, × ½; enlarged flower, × 3.

del. J. A. Steyermark.

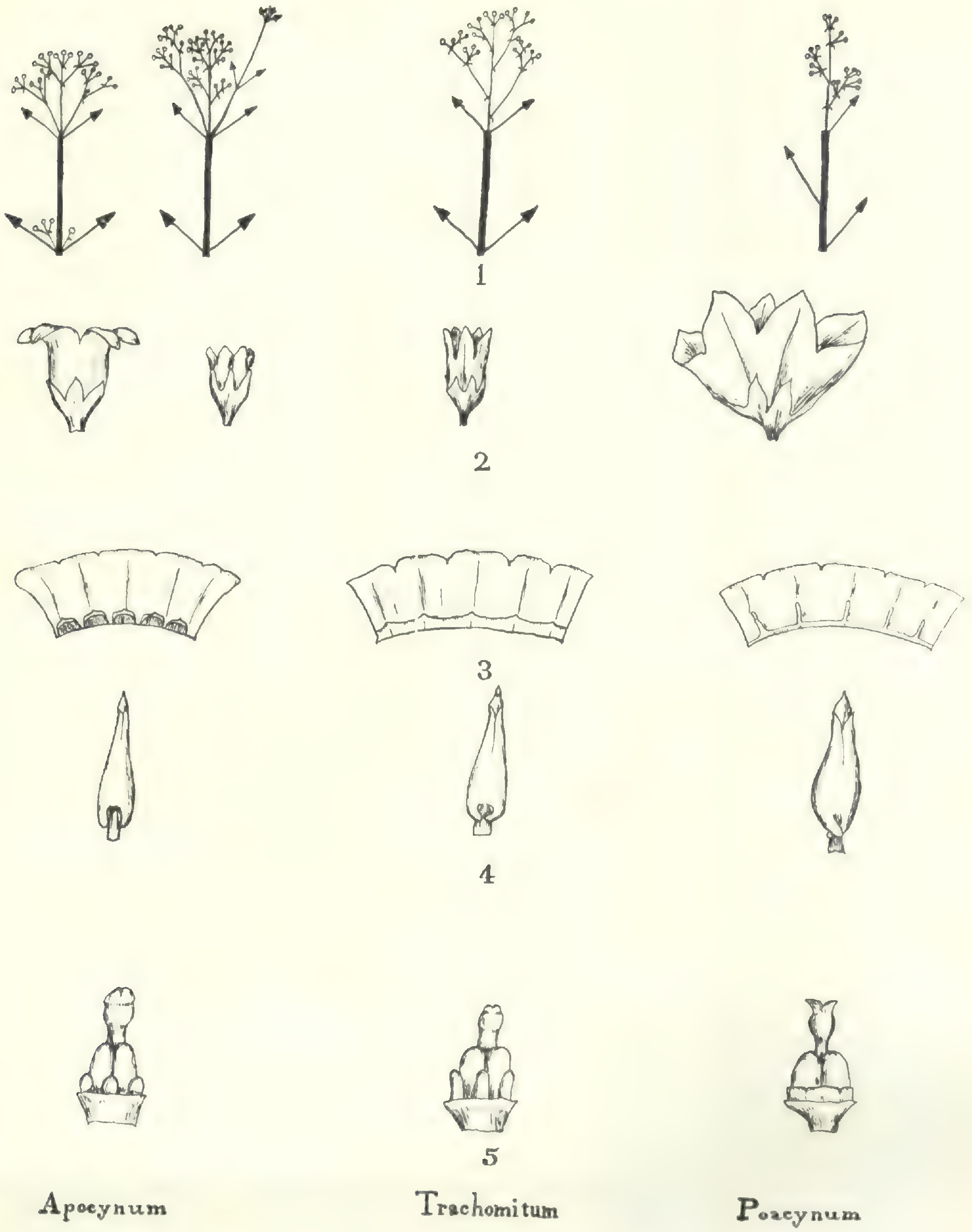
WOODSON—APOCYNACEAE

COCKAYNE, BOSTON

Explanation of Plate

PLATE 20

Comparative morphology of *Apocynum*, *Trachomitum*, and *Poacynum: 1*, inflorescence; *2*, exterior of flower; *3*, interior of corolla, indicating the corollar appendages; *4*, rear of stamen, illustrating the auriculate anther; *5*, gynoecium, illustrating the clavuncle, carpels, and nectaries.



WOODSON—APOCYNACEAE

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STUDIES IN THE UMBELLIFERAE. III[1]

A MONOGRAPH OF CYMOPTERUS INCLUDING A CRITICAL STUDY OF RELATED GENERA

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Formerly Jessie R. Barr Research Fellow in the Henry Shaw School of Botany of Washington University

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[1] An investigation carried out at the Missouri Botanical Garden in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University, and submitted as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy in the Henry Shaw School of Botany of Washington University.

Issued December 27, 1930.

I

Introduction

The problem of generic delimitation in the Umbelliferae of western North America has caused great confusion in recent years. This confusion has been particularly evident in the group of genera centering around the *Cogswellia* and *Cymopterus* types. Some workers are inclined to treat these groups as composed of many comparatively small genera; others have on the contrary considered them as two "polymorphous" genera composed of a number of distinct sections or subgenera. The present study was undertaken in an endeavor to give a comprehensive monographic treatment of the genus *Cymopterus*. As the study developed the necessity arose for defining and delimiting the various generic elements which have been confused with *Cymopterus*. Thus the present paper is a monographic treatment of that genus as well as a survey of the *Cymopterus* complex. There are some fifteen genera involved, among them *Phellopterus, Pseudocymopterus*, and *Aulospermum*. Several of these genera are founded on segregates from *Cymopterus* while others are so closely related as to cause confusion. In the first part of this paper *Cymopterus* is discussed in detail and the relationships of the other genera to the *Cymopterus* type stressed. In the remainder of the paper the various genera are delimited and given a taxonomic treatment.

At this time the writer wishes to express her appreciation and gratitude to the people who have made this study possible. Thanks are due Dr. George T. Moore, Director of the Missouri Botanical Garden, for the use of the excellent library and herbarium facilities which this institution afford. Sincerest appreciation is due Dr. J. M. Greenman, Curator of the Missouri Botanical Garden, under whose guidance this study has been carried on, for the aid and advice which were so willingly given at all times.

Special thanks are due those in charge of the herbaria of the following institutions for their courtesy in extending the privilege of examining material deposited there and for the loan of material necessary for this study: the Gray Herbarium of Harvard University, the New York Botanical Garden, the Brooklyn Botanic

Garden, the New York State Museum, the Academy of Natural Sciences of Philadelphia, the United States National Museum, Carnegie Museum, Pittsburgh, the Field Museum of Natural History, the Herbarium of the University of Chicago deposited in the Field Museum of Natural History, the Edward L. Greene Herbarium at Notre Dame University, Iowa Agricultural College, the University of Colorado, Pomona College, the California Academy of Sciences, and the Dudley Herbarium of Leland Stanford, Jr. University.

For the loan of material in connection with this study the writer is indebted to those in charge of the herbaria of the University of Wyoming, the University of California, the University of Oregon, the State College of Washington, the University of Minnesota, Nevada Agricultural Experiment Station, Brigham Young University and the National Museum of Canada. The writer has appreciated the opportunity of examining specimens in the private herbaria of Prof. M. E. Jones, Claremont, California, and Mr. George J. Goodman, Missouri Botanical Garden.

Appreciation is due Dr. J. H. Barnhart of the New York Botanical Garden, Dr. John Briquet of the Botanical Conservatory of Geneva, and Dr. Alfred Rehder and Miss E. M. Tucker of the Arnold Arboretum for their assistance in bibliographical matters concerning various genera; to Dr. A. B. Rendle of the British Museum and Dr. A. W. Hill and Mr. T. A. Sprague of the Kew Herbarium, for their kindly assistance in locating the type specimen of *Cymopterus* and for the photograph of it which was magnanimously supplied; and to Dr. L. Diels of the Botanical Garden and Museum of Berlin-Dahlem for a fragment of the type specimen of *Musineum Ehrenbergii.* Sincere appreciation is due Dr. D. H. Linder of the Missouri Botanical Garden for his valuable assistance in the preparation of microphotographs, and Dr. R. V. LaGarde and Mr. Paul Kohl of the same institution for the preparation of photographs of specimens used in this paper. The author is indebted to many others for their assistance in the numerous details of this study.

II

History of the Genus Cymopterus

The genus *Cymopterus* was first described by Rafinesque[1] in his 'Prodrome des nouveaux Genres de Plantes' published in 1819. The genus was based on *Selinum acaule* of Pursh[2] and on *Thapsia glomerata* of Nuttall.[3] These two species were correctly treated as conspecific by Rafinesque; because of priority the first named must be taken as the historical type of the genus. *Selinum acaule* was based on plants collected by John Bradbury "on the alluvion of the Missouri, from the river Naduet to the Mahas"[4] in "upper Louisiana" [from a few miles north of the present site of St. Joseph, Missouri, to Sioux City, Iowa]. *Thapsia glomerata* was based on a collection of Thomas Nuttall "On the open plains of the Missouri, commencing 40 miles below the confluence of White river"[5] [southern South Dakota]. These plants were collected in 1811 on a journey which Nuttall and Bradbury made from St. Louis, Missouri, to the Mandan Villages on the upper Missouri River, now near Bismarck, North Dakota.

The first review of the genus following its original publication was by de Candolle[6] in 1830 in the 'Prodromus.' Only one species was recognized, namely, *Cymopterus glomeratus*. Nuttall[7] in 1834 described another species, *Cymopterus glaucus*. A comprehensive treatment of the genus was made by Torrey and Gray[8] in 1840. They recognized and described eight species, namely, *Cymopterus glomeratus*, *C. montanus*, *C. glaucus*, *C. campestris*, *C. terebinthinus*, *C. foeniculaceus*, *C. albiflorus*, and *C. thapsoides*, which were placed in four sections—*Eucymopterus* of Torrey and Gray, *Phellopterus*, *Leptocnemia*, and *Pteryxia*, of Nuttall.

The genus *Cymopterus* has been surveyed in the various floras of the western region of North America where it is of common

[1] Rafinesque, Jour. Phys. **89**: 100. 1819.

[2] Pursh, Fl. Am. Sept. **2**: 732. 1814.

[3] Nuttall, Gen. **1**: 184. 1818.

[4] Bradbury, Cat. 1819 [reprinted in Thwaite, Early West. Trav. **5**: 318. 1904].

[5] Nuttall, Gen. **1**: 185. 1818.

[6] De Candolle, Prodr. **4**: 203. 1830.

[7] Nuttall, Jour. Acad. Phila. **7**: 28. 1834.

[8] Torrey and Gray, Fl. N. Am. **1**: 623. 1840.

occurrence. Between 1840 and 1888, when the 'Revision of North American Umbelliferae' by Coulter and Rose[9] appeared, fourteen species and two varieties were published under the generic name *Cymopterus*. Bentham[10] recognized the genus and attributed to it some ten species. The new genus *Phellopterus* was described by him and based on *Cymopterus littoralis*. Watson[11] in 1887 described the genus *Podistera*, basing it on *Cymopterus nevadensis*.

In the 'Revision' of Coulter and Rose[12] only one species was added to the genus but a number of previously published species were transferred to other genera, as only thirteen species were recognized in the genus *Cymopterus*. The new genus *Coloptera* contained three species which were considered closely related to *Cymopterus;* and the new genus *Pseudocymopterus* also contained three species, two of which had previously been described under *Cymopterus*.

In Drude's[13] survey of the Umbelliferae for 'Die natürlichen Pflanzenfamilien' these three genera were recognized and treated according to the Coulter and Rose 'Revision.'

The next treatment of the genus *Cymopterus* was by Coulter and Rose[14] in their 'Monograph' in 1900. They recognized only seven species; the genus *Coloptera* was reduced to synonymy under *Cymopterus;* however, *Pseudocymopterus* was retained as a generic element. Species which had originally been described under *Cymopterus* were to be found in eight other genera, namely, *Podistera, Oreoxis, Rhysopterus, Phellopterus, Aulospermum, Pteryxia, Pseudocymopterus*, and *Glehnia*.

Jones[15] in 1908 surveyed the genus *Cymopterus*, and reduced the genera *Rhysopterus, Phellopterus, Aulospermum, Pteryxia, Oreoxis*, and *Pseudocymopterus* to sectional rank under *Cymopterus*, recognizing forty-four species in the genus.

In 1913 Rydberg[16] described the genus *Coriophyllus*, formerly

[9] Coulter and Rose, Rev. N. Am. Umbell. 1888.
[10] Bentham, in Bentham and Hooker, Gen. Pl. 1: 911. 1867.
[11] Watson, Proc. Am. Acad. 22: 475. 1887.
[12] Coulter and Rose, Rev. N. Am. Umbell. 1888.
[13] Drude, in Engler and Prantl, Nat. Pflanzenf. 3[8]: 221. 1898.
[14] Coulter and Rose, Contr. U. S. Nat. Herb. 7: 179. 1900.
[15] Jones, Contr. West. Bot. 12: 16–29. 1908.
[16] Rydberg, Bull. Torr. Bot. Club 40: 69. 1913.

treated as a section of *Cymopterus* by Jones. He also described the genera *Pseudopteryxia*[17] and *Pseudoreoxis*,[18] both based on species of *Cymopterus*.

Thus recent workers have been doubtful as to the course to pursue in treating these genera. There are two methods of procedure in use—that of Jones, who treats all the genera mentioned as mere variants of one large generic concept, and that of Coulter and Rose, and of Rydberg, who recognize the different elements as being generically distinct. Both methods of procedure have been followed in recent years by authors of local manuals.

General Morphology

COMPARATIVE MORPHOLOGY OF THE GENERA WITH SPECIAL REFERENCE TO THE GENUS CYMOPTERUS

Habit and Habitat.—The various genera included in this survey have for the most part a xerophytic or semixerophytic habit. They occur practically without exception in the dry, sandy, or alkaline regions of western North America and usually in more elevated habitats. They are all herbaceous perennials, glabrous or pubescent, frequently caespitose, caulescent or acaulescent. The genus *Cymopterus* occurs in arid or semi-arid regions from central Saskatchewan to northern Mexico and from western Minnesota and central Nebraska to eastern California in elevations from approximately one thousand to eleven thousand feet. The plants are glabrous except for an occasional pubescence of the fruit and the puberulent foliage of one species, *C. cinerarius;* and are strictly speaking acaulescent although certain species become subcaulescent through the development of a pseudoscape.

Roots.—The roots are those typical of most Umbelliferae. With few exceptions they are fleshy and tuberous and much elongated, seldom branching, and of the perennial, or at least biennial, type. In certain species a bulbous growth is developed; but in no case are the roots fibrous or filiform. The genus *Cymopterus* never develops a bulbous root, but has a fleshy, subfusiform, usually much elongated tap-root, rarely branching.

[17] Rydberg, Bull. Torr. Bot. Club **40**: 71. 1913.

[18] *Ibid.*, 73. 1913.

Stems.—Certain genera are typically caulescent with usually simple unbranched grooved stems. The stems are mostly glabrous, but one example of a pubescent condition is the hirtellous development at the base of the umbel in certain species of the genus *Pseudocymopterus.* Probably the predominating condition is the development of only subterranean stems, giving the plant an acaulescent appearance. In certain genera a so-called "pseudoscape" is developed which is comparable to the stem and morphologically equivalent to it (pl. 25, fig. 1). It is produced by the subterranean stem becoming elongated and bearing at its apex a cluster of leaves and peduncles—a situation typified by the genus *Aulospermum.* This pseudoscape, however, may never be raised above the surface of the ground, so the plants retain their acaulescent appearance. The genus *Cymopterus* is essentially acaulescent, some species growing practically prostrate with only leaves and peduncle above the surface of the ground. The development of a pseudoscape always characterizes certain species. The peduncle is of varying length—shorter than or exceeding the leaf cluster—and always glabrous.

Leaves.—The leaves are alternate, and usually develop a dilated petiole which forms a sheath at the base. They may be ternate, palmate or pinnate, and generally become much divided. There is a variation from coriaceous and subcoriaceous leaves with cartilaginous margins to thin, submembranous leaves with entire undifferentiated margins. The ultimate leaf divisions are in many species definitely linear; in other species they attain a width of about three centimeters. For the most part the leaves are glabrous but exceptions occur in several species, the most pronounced being in the case of *Glehnia leiocarpa,* which always has a dense tomentum developed on the under surface of the leaf.

The leaves of the genus *Cymopterus* in those species developing a pseudoscape appear whorled at its apex. The petioles are sheathing and surround the pseudoscape or peduncle base. The leaves are bipinnate to quadripinnate, appearing as ternate in certain species due to the confluence of the pinnae. They vary from coriaceous and subcoriaceous with cartilaginous margins to thin, submembranous ones with undifferentiated margins.

The ultimate leaf divisions in some species are linear and remote, in others more or less confluent. Certain species, such as *C. Newberryi*, have mostly broader ultimate leaf segments. The leaf margins may be lobed or entire and the apex of the ultimate segment may be apiculate.

Inflorescence.—The inflorescence is in all cases a compound umbel, and the number of umbellets varies. The umbellets may be sessile or borne on long rays, resulting in the former case in a dense globose inflorescence and in the latter in a widely spreading type. The involucre is mostly absent but may occur in the form of a low sheath, one or two small, inconspicuous, linear, foliaceous bracts or even develop more or less conspicuous, partially united, scarious bracts which characterize the genus *Phellopterus*. The involucel varies from small, inconspicuous, thin bracts to the conspicuous, subulate bracts in species of *Pseudocymopterus;* to the prominent, dimidiate, foliaceous bracts of some species of *Cymopterus;* and to the large, scarious, sometimes many-nerved, bracts of *Phellopterus*. The inflorescence is usually glabrous, but in some species the rays and pedicels may be scabrous-pubescent and the involucre and involucel also may become pubescent.

The inflorescence of the genus *Cymopterus* varies greatly. In certain species, such as *C. deserticola* and *C. globosus*, the primary and secondary rays have become aborted and fused, forming a discoid inflorescence. In other species the umbellets may be borne on long rays, giving a spreading inflorescence type. All intermediate stages occur, resulting in a variation from the discoid rayless inflorescence through a globose type with very short rays to a widely spreading umbel. The involucre may be entirely absent, or present as a low, inconspicuous sheath, occasionally toothed and sometimes definitely bracteoid. The involucel is characteristic for the genus, being conspicuous in most species and composed of dimidiate, scarious, whitish, purplish or green, typically foliaceous bracts. In such species as *C. globosus* and *C. deserticola*, in which the inflorescence is discoid, the involucel bracts are inconspicuous, scarious, and paleaceous

Flower.—The flowers are small, epigynous, with five sepals which are often inconspicuous, five petals and stamens, and a bicarpellary pistil although three carpels may rarely occur.

Calyx.—The calyx lobes are usually inconspicuous and not persistent, although exceptions occur in such genera as *Musineon* and *Pseudocymopterus*, with conspicuous, persistent, subulate calyx lobes. The genus *Cymopterus* has mostly non-persistent calyx lobes but in some species the teeth are conspicuous at the apex of the mature fruit.

Corolla.—The corolla is that typical for the family. The petals are concave with inflexed tips, and vary from white or yellow to purple.

Stamens.—There are five alternate introrse stamens which are similar in all the genera.

Pistil.—The pistil is bicarpellary and surmounted by a disk which in a number of species has been confused with the stylopodium. This disk may become quite fleshy and prominent. With the exception of the genus *Podistera* no stylopodium occurs in the group. The style may become reflexed and is usually persistent. However, in the genus *Cymopterus* the style rarely persists.

Fruit.—The fruit may be sessile or pedicellate. It is bicarpellary (rarely a tricarpellary condition occurs), the two carpels being in contact on their commissural surfaces (pl. 21, fig. 3b, fig. 4h). In most of the genera the commissural surface is broad and the carpels are in close contact until maturity; in other genera the commissure is quite narrow, the two carpels appearing distinct, as in *Harbouria*. The carpophore (pl. 21, fig. 1a), a portion of the receptacle prolonged between the carpels as a central axis, may be entire or two-parted, and may or may not be persistent. The fruit may be compressed laterally, at right angles to the commissural plane, or dorsally, parallel to the commissural plane, or this compression may be practically absent.

The carpel surface is usually marked by five longitudinal ribs or wings. The two nearest the commissure are known as the lateral wings (pl. 21, fig. 2a, fig. 4e); those on the back of the carpel have been referred to as the dorsal wings (pl. 21, fig. 2b, fig. 4a). Technically the wing on the center back of the carpel is the dorsal wing and the ones between it and the laterals are the "intermediate" wings. In this paper the intermediate and dorsal have been merged under the latter term. When only

one dorsal wing is present it may be inferred that it is normally centrally placed on the back of the carpel; in some fruits the so-called "intermediate" wings develop and the "dorsal" wing remains as a rib; in others three or four wings may be developed on the dorsal surface. Thus it has seemed best to include all the wings, excepting the laterals, under the general term of dorsal wings. There may also be developed secondary ribs. The condition in the group thus varies from a carpel with inconspicuous ribs to one with both dorsal and lateral wings conspicuously developed. The wings and ribs vary greatly in size and shape. The ribs may appear as inconspicuous protuberances on the carpel surface or may become quite conspicuous as in *Aletes*. The wings in cross-section may be short or extended linear projections; may be constricted at the base, then abruptly broadened and acuminate at the apex; or they may be inflated at the base and abruptly constricted to a linear projection toward the apex (pl. 22, fig. 11). The texture of the wings varies from a thin, scarious one through a spongy tissue to a definite corky development. A subcartilaginous epidermal structure may even develop.

Oil tubes are present in all the genera; their size, number and position, however, is variable even within the genus. They may be solitary in the intervals as in species of *Oreoxis* and *Aletes;* or there may be as many as eight or more oil tubes in each interval; on the commissural surface the oil-tube number varies from two to twenty or more. In certain species there is an accessory oil tube in each rib. A number of species have oil tubes in the ribs or wings—at the wing-base, in the inflated portion of the wing, or in the apex. The oil tubes are usually arranged in definite areas surrounding the seed but at times they may be scattered throughout the pericarp.

Strengthening cells may or may not be developed at the wing bases. This strengthening tissue may be composed of vascular elements or of only a small-celled parenchyma. As a rule it merges gradually into the other tissue.

The fruit is usually glabrous but a pubescent condition occurs in certain species. A thick tomentum may cover the carpel, the apex only may be pubescent, usually with multicellular hairs, or the commissural surface may be puberulent to scaly-

tomentose. In other genera the fruit is merely tuberculate—the degree varying from a slight tuberculation between the ribs to a condition covering the entire fruit.

The genus *Cymopterus* presents a number of interesting fruit characters. The fruit is pedicellate or sessile, and normally compressed dorsally. The outline of the fruit varies from ovate or ovate-oblong to narrowly cuneate or oblong with an abrupt constriction below the middle. This latter outline is largely due to the compression within the umbel, a varying condition in each species. Lateral wings are always developed; these may or may not be constricted at the base in cross-section; in certain species they are definitely inflated at the base. The dorsal wings vary greatly. In *C. acaulis* and *C. Fendleri* one to three dorsal wings occur; both the dorsals and laterals are constricted at the base. *Cymopterus Newberryi* shows a variation from a carpel with only lateral wings to one with dorsals fully developed. In those forms with only lateral wings developed the sections show evidence of abortion of the dorsals, the prevalent condition throughout this species. *Cymopterus deserticola* presents a condition with lateral wings fully developed and the dorsals remaining as slight projections on the carpel surface. *Cymopterus Coulteri*, *C. globosus*, and *C. cinerarius* have carpels with the wings rarely constricted at the base but usually tapering gradually from base to apex.

The oil-tube number is also variable in the genus; there may be one to many oil tubes in the intervals and two to many on the commissure. Certain species may have an accessory oil tube developed in each wing.

Strengthening cells may be formed at the wing base but in some species they are always absent.

The fruit may be entirely glabrous or puberulent to scaly-tomentose on the commissural surfaces and pubescent at the tip with multicellular hairs as is the case in *C. megacephalus* and *C. deserticola*.

EVALUATION OF CHARACTERS USED IN CLASSIFICATION

The Umbelliferae as a family has always caused much perplexity. The absence for the most part of floral characters useful

in diagnosis has created its reputation as a difficult group. The North American genera of the family have received various treatments, largely due to the small amount of material available for study.

The treatment of Torrey and Gray,[19] the first comprehensive survey of the North American genera, was based on a relatively small amount of material. As a consequence their genera at times were exceedingly heterogeneous as to morphological relationships. Gray's opinion is expressed in a letter which he wrote to Sir George Bentham in 1867:—"As to Umbelliferae, I wish you joy of the job, and do hope you will reduce the genera twenty percent at least. I never could take the least satisfaction in them. I never could collate our Umbelliferae with European genera, and I have no clear conception of more than half a dozen of our genera . . ."[20]

One of the difficulties encountered in the earlier treatments of the North American genera was this attempted identification with European forms when many times the characters in common were merely superficial ones of appearance.

An opposing view is given by an earlier worker:—"it is, . . . in Umbelliferae, . . . indispensible that the genera should be confined within the most exact limits; and it is far better that this should be effected by the creation of many new genera, than that it should not be done at all."[21]

This illustrates the conflicting views concerning the treatment of the North American Umbelliferae. The question has been as to what constituted a genus—is the family made up of a number of small or even monotypic genera or is it composed of relatively few large polymorphous groups? One of the purposes of this study has been to ascertain what characters can be considered as constant in the delimitation of both genera and species.

The stress has formerly been laid on detailed fruit characters, at times to the elimination of all other possibilities. As a consequence heterogeneous groups have been merged because of such microscopical characters as oil-tube number. The statement of

[19] Torrey and Gray, Fl. N. Am. 1: 623. 1840.
[20] Gray, J. L. ed., Letters of Asa Gray 2: 553. 1893.
[21] Lindley, in Edwards' Bot. Reg. 18: *t. 1486.* 1832.

Coulter and Rose in their 'Revision' illustrates this point of view: "The order must still be considered a difficult one to the ordinary student, inasmuch as it demands careful sections of the fruit and an examination of rather minute structures."[22]

The classificatory value of various characters has also been briefly discussed by them: "We have therefore divided our *Umbelliferae* into two series, based upon the development of secondary ribs or not, . . . Our second series, which is by far the larger, we have broken into groups based upon the flattening of the fruit, which seems to be a very reliable character, and one which best groups together related genera. Characters which are used in further subdivisions, enumerated in the order of their general importance, are as follows: flattening of the carpel, nature of the stylopodium, winging of the fruit, character of the seed-face, number of oil-tubes, and general habit. Thus genera are reached, and in a way that seems to express relationship as well as can be done in any lineal arrangement."[23]

It may be seen from the above that practically all the generic characters are based on the fruiting condition, and many of these are apparent only after detailed examination and sectioning.

In the course of this study material has been obtained from the larger herbaria of the country as well as from the local herbaria in the regions where the genera are indigenous. A detailed morphological study has been made of every species to determine the range of variation of all its characters. The characters previously used in the classification of the groups studied have been tested with the unusually large amount of material available. In the case of the genus *Cymopterus* a detailed study of every specimen has been made especially in connection with fruit characters. Free-hand or microtome sections were made of all fruiting material in order to show the variation within the species, individual umbel, and between the two mature carpels of one fruit.

The herbarium material for free-hand sections was soaked in distilled water or a two per cent solution of potassium hydroxide from twelve to forty-eight hours, boiled one-half to five minutes

[22] Coulter and Rose, Rev. N. Am. Umbell. 3. 1888.
[23] *Ibid.*, 15–16. 1888.

in water or sectioned without boiling, sectioned in pith, dehydrated in absolute alcohol, and mounted in glycerine. At times material was boiled immediately in water without the long preliminary soaking. There was no apparent difference in the sections due to the various treatments given the fruits.

The fruits used for microtome sections were soaked in distilled water over night, boiled one-half to five minutes in a two per cent solution of potassium hydroxide, dehydrated, and embedded in paraffin as usual. Serial sections were cut at a thickness of six microns and stained with a one per cent aqueous solution of gentian violet and a one-half per cent clove-oil solution of erythrosin. The method was adapted from that used by Mrs. Haber[24] in her studies on *Euphorbia,* with changes made to suit the material.

These sections proved very satisfactory for a study of the fruit—shape and composition of the wings; origin, number, and variation of oil tubes; and vascular structure. Since the fruit characters have been considered of prime importance in the family they shall be discussed first.

The general outline of the carpel has been found to be a very constant character within a species or group of species. The outline is only rarely affected by the compression within the umbel or by the drying of the specimen. When the outline is due to the compression within the umbel it is as a rule constant for the species—as, for example, the narrowly cuneate or abruptly constricted fruits of *Cymopterus globosus.* The compression of the fruit is a much more variable character. As a rule this compression remains within certain limits in each genus, and laterally compressed fruit may readily be distinguished from that dorsally compressed. But there are a great many intermediate stages—some fruits practically non-compressed, others so intermediate that the interpretation depends on the individual point of view. For those groups with definite laterally or dorsally compressed fruits this character has been found very useful generically. For the remaining groups the character is very doubtful and has not been found of any value.

The winging of the fruit is a character of great importance

[24] Haber, Julia M. Ann. Bot. 39: 661. 1925.

but one frequently over-stressed. An excellent example is the case of the species, *Cymopterus Newberryi*. A superficial examination of a small amount of material would probably lead one to the conclusion that only lateral wings are developed, and rarely one dorsal wing appears as a ridge on the carpel surface. Yet an examination of a series of fruits has shown the variation to range from a carpel with only laterals to one with both laterals and dorsals. An extreme example of this is illustrated by fig. 3 of plate 25, which shows a cross-section of the two carpels of one fruit. An examination of microtome sections has shown that when the dorsal wings have not developed the vascular tissue and oil tubes indicate their normal position and the fact that they have been aborted (pl. 25, fig. 2). In this group of genera lateral wings are present in all the winged fruits. Certain genera have only rib development. Dorsal wings may be absent entirely, absent through abortion as illustrated (pl. 25, fig. 3), present as one to three inconspicuous ridges on the dorsal surface of the carpel, or there may be one to four dorsals as conspicuous as the laterals and of the same form. This variation is of value both specifically and generically if a large series of specimens has been critically examined. Certain genera are characterized by the constant presence of both lateral and dorsal wings, others by the presence of laterals only. The genus *Cymopterus*, however, presents both conditions. But in this genus if the dorsals are completely absent vascular evidence indicates their point of origin. And the variation within an umbel may cover the range of variation for the genus. This character when used in combination with others has proved of specific value in this genus,—for example, *C. deserticola* (pl. 23, fig. 3) has a carpel with only dorsal ridges developed; its closest relative, *C. megacephalus* (pl. 23, fig. 4), develops a prominent wing on the dorsal surface of the carpel.

The dorsal wings as a rule are not greatly convoluted, but *Cymopterus corrugatus* is characterized by the constant corrugated appearance of the dorsal wings—a character which will readily separate this species in the fruiting stage from all others.

The shape of the wing in cross-section is a very constant character and usually one of great value in diagnosis; as both a

generic and specific character it has been found most useful. Every genus as a rule possesses a predominating wing outline. The condition in the genus *Cymopterus* is usually that with a constricted wing-base. Wing types for the various genera and species are illustrated in plates 22-25. The range of variation within the group is shown (pl. 22) and also within the species (pl. 24, figs. 1–14) and genus (pl. 24, figs. 14–23). It may be seen that the wing outline is extremely constant within the species.

The texture of the wings can also be used to some extent in diagnosis, although degrees of difference in texture are difficult to express objectively. There is a generic and specific variation in cellular structure resulting in scarious to subcartilaginous wings.

The length of the wing in cross-section as compared with the carpel breadth is a character frequently of value in specific analysis.

The number of oil tubes has been used as a very important character in separating the family into groups. The key given by Coulter and Rose[25] in their 'Monograph' has as the third main subdivision of the genera the presence of a solitary oil

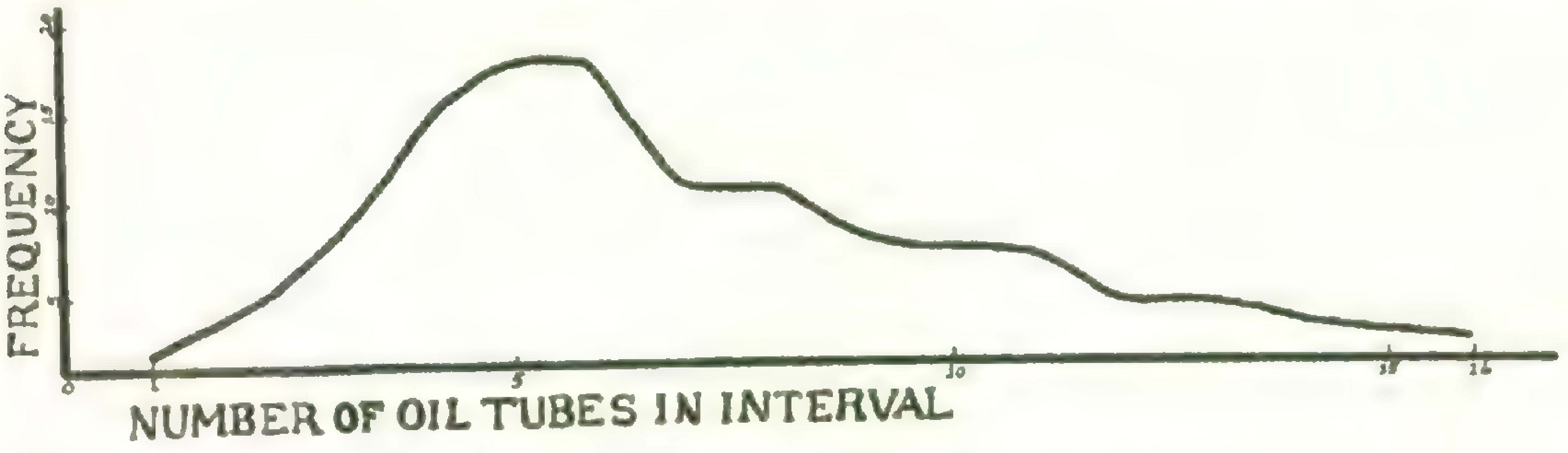

Fig. 1. Graph showing the range of variation in oil-tube number in the intervals of mericarps of *Cymopterus Fendleri*.

tube as contrasted with several oil tubes in the intervals. Too much stress has been placed on the value of oil-tube number as a diagnostic character. It is a valuable character to a very limited degree. Again it is most essential to know as nearly as possible the range of variation within a species and within a single umbel. Also the plane in which the section is cut is of

[25] Coulter and Rose, Contr. U. S. Nat. Herb. 7: 21. 1900.

great importance. Serial sections in paraffin of a number of carpels show a wide range of variation from base to apex in the same carpel. If all sections were made in the median plane a basis of comparison might be reached, but here again the personal equation interferes. Figure 1 shows graphically the range of variation within the species *Cymopterus Fendleri*. It is recognized that generally the presence of only one oil tube in the interval is fairly constant and dependable; yet exceptions occur as illustrated in pl. 22, fig. 7, and pl. 23, fig. 2. The number of oil tubes on the commissural surface is more limited in variation but not of any great value specifically.

The size of the oil tubes, as a rule, depends on the number present. When the oil tubes are solitary in the intervals they are much larger than in those cases with numerous oil tubes in the intervals. The shape varies also, appearing in cross-section from round to elongated-elliptical and lenticular. The position of the oil tubes presents many interesting variations. In the majority of genera studied the oil tubes are arranged in a definite row around the seed, as exemplified by *Cymopterus acaulis* (pl. 24, fig. 21). The genus *Neoparrya* (pl. 22, fig. 2), on the other hand, has oil tubes scattered throughout the pericarp. In addition to these there may be accessory oil tubes located singly in the wings. They are much smaller than the others, appearing at the base, apex, or in the inflated portion of the wing, usually in connection with strengthening tissue.

The vascular tissue in the carpels is at times apparently absent, at others conspicuous—a condition almost specific in its occurrence. The present study has shown the occasional presence of one to three strands near the wing base and vascular elements in the carpophore, but the vascular study has not been sufficiently complete to warrant any conclusions concerning its phylogenetic significance.

The persistence of the carpophore has been found to be usually of generic constancy and is an easily observable character in any fruiting specimen.

There are a number of inflorescence characters which have not been used to any great extent beyond occasional specific delimitations. The length of the primary and secondary rays is a specific

character—varying for each species within more or less definite limits. The complete abortion of the rays in certain species of *Cymopterus* resulting in a discoid inflorescence is a constant character for an entire group of species. This discoid development is apparently due to a shortening and fusion of the primary and secondary rays and is correlated with other specific differences, indicating that it is not a chance fasciation occurring in any species. *Cymopterus acaulis* is characterized by relatively short rays resulting in a globose inflorescence, while in *C. Fendleri* and *C. Newberryi* the rays are as a rule much longer, resulting in a more or less spreading type of inflorescence.

The involucre and involucel (pl. 21, fig. 1*c*,*e*) are characters of great value specifically and generically—being apparent in either fruiting or flowering condition. Rafinesque in his 'Scadiography' made an interesting comment concerning these characters: "and the essential form of the common and partial involucres no longer neglected, since they are as important as those of the perianthe of compound flowers, being both bracts assuming a floral importance, when the flowers are so much alike.

"It is the same for the bracteal glumes of Grasses that give generic characters, and wherever the bracts offer more diversities than the uniform flowers."[26]

The presence or absence of the involucre is a relatively uniform character for the species. At times the type of involucral bracts is a reliable character but in some species the range of variation is too great in this respect. The texture of the bracts is in some cases constant for an entire genus, as, for example, *Phellopterus*, which is always characterized by a scarious involucre.

The involucel is a more prevalent structure and fairly constant as to form and texture for the genus. The dentation and venation of the involucel bracts are valuable characters specifically.

The flowers in this group are too uniform to present any characters of classificatory value. Their color has been used to some extent but the variation may be from white to purple within a species or on the same plant. In the young carpel a number of the fruit characters are visible—wing number and

[26] Rafinesque, C. S. Scadiography or 100 G. of Ombelliferous plants etc. The Good Book 1: 60. 1840.

position and occasionally oil-tube number can be determined from sections of very young carpels.

The peduncle presents an interesting character in its length. Some species have very short peduncles, the inflorescence being

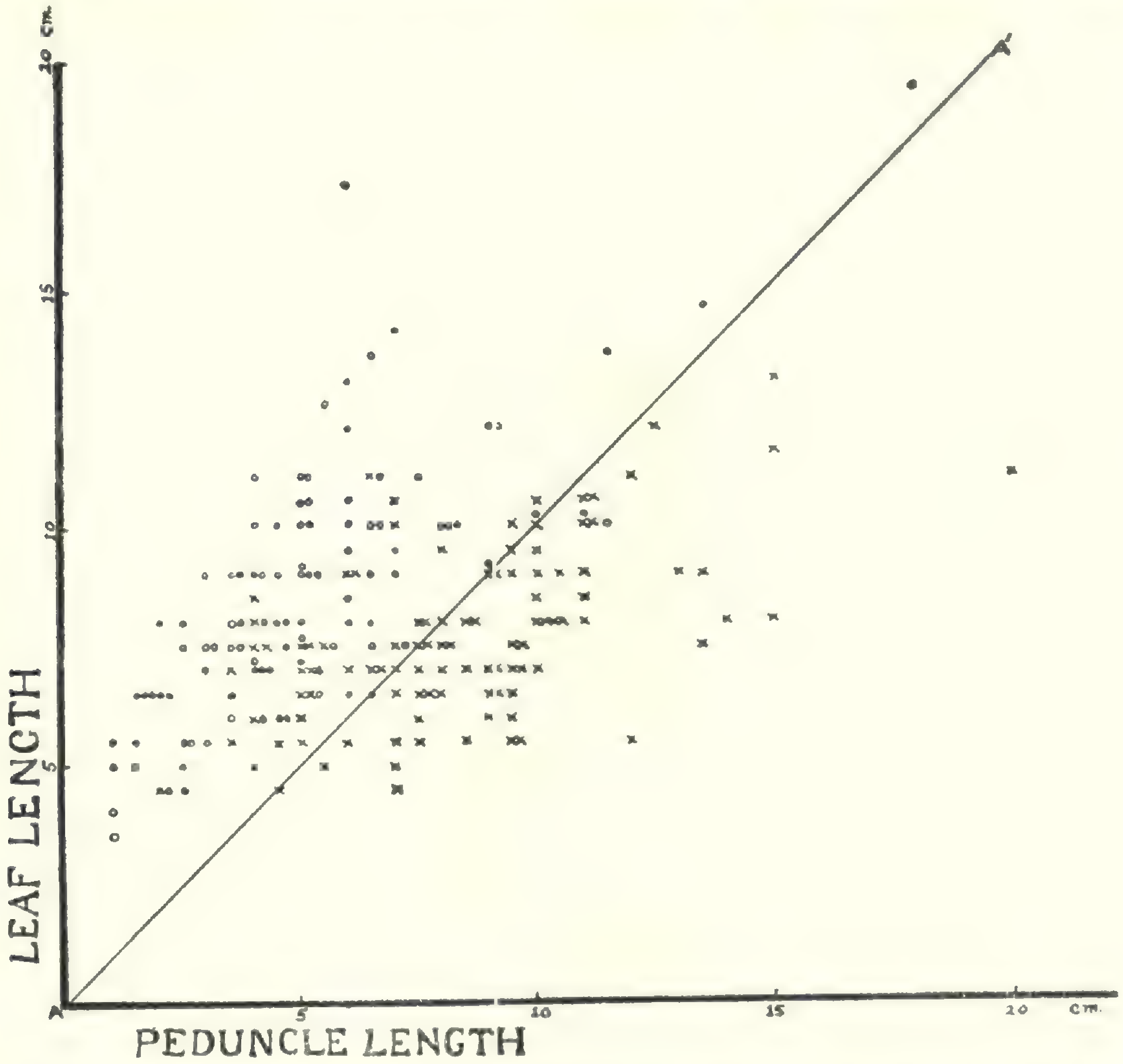

Fig. 2. Correlation table illustrating the relation between peduncle length and leaf length in two closely related species, *Cymopterus acaulis* and *C. Fendleri*. The measurements are from one hundred typical individuals of each species.

xx *C. Fendleri*
oo *C. acaulis*

practically sessile in the axils of the leaves; others have peduncles much longer than the leaves. The comparative relation of peduncle length and leaf length is a constant character for a species, and a study of this ratio has been made in some detail for two closely related species—*Cymopterus acaulis* and *C. Fendleri*. The results of this study are set forth in the above

correlation table (fig. 2). It may be seen that in spite of the overlapping each species shows a different developmental tendency. The peduncle becomes lengthened as the plant matures

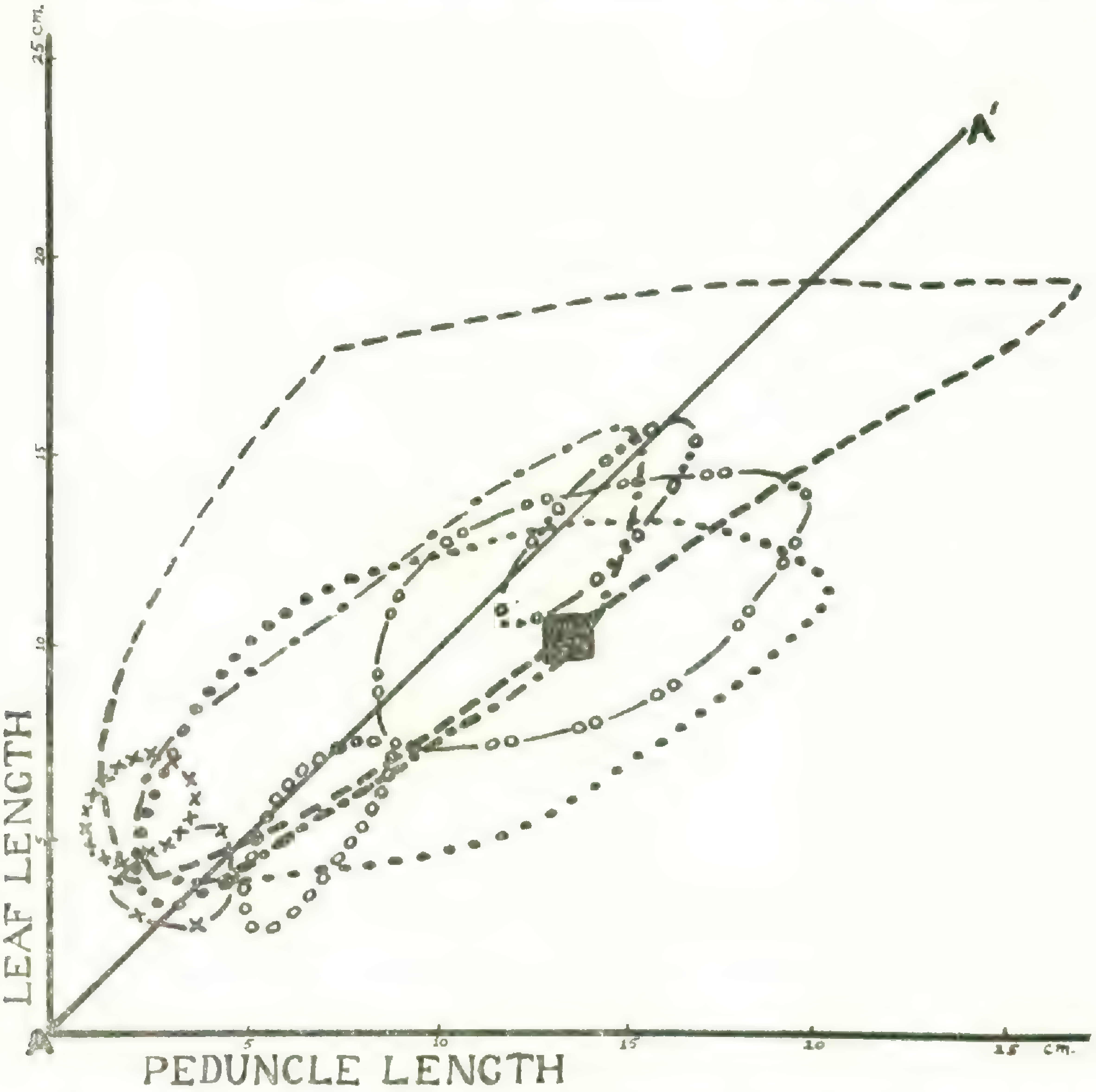

Fig. 3. Correlation table illustrating the relationship expressed by the species of *Cymopterus*, based on the comparative lengths of peduncle and leaf. The limits of variation are outlined, showing the results of a study of all available material.

- - - - - *C. acaulis*	■ *C. megacephalus*
• • • • • *C. Fendleri*	•-•-• *C. globosus*
OO—OO *C. Newberryi*	OOOOO *C. cinerarius*
O • • O— *C. deserticola*	X-X-X *C. Coulteri*

XXXXX *C. corrugatus*

but a more or less constant ratio is preserved between the peduncle length and leaf length. Figure 3 illustrates the relationship of the various species of *Cymopterus* based on the comparative lengths of peduncle and leaf.

The division of the leaves is constant within the species—ternate or twice-ternate, and simply pinnate to quadripinnate. The frequent confluence of the ultimate segments makes it difficult at times to determine the degree of division. Some assistance is obtained by tracing the vascular system through the leaf. In this study the length and breadth of the ultimate leaf segments (pl. 21, fig. 1*s*,*t*) have been measured, and the character has been used in a definite delimitation of the species. The ratio of ultimate segment length to breadth is a constant specifically. The leaf-length/leaf-breadth ratio has also been studied. Here again it is relatively constant for the species. The general outline of the leaves also adds a useful character. The leaf texture is specific but, as in the case of wing texture, the difficulty arises in expressing the differences objectively.

The pseudoscape development is quite constant throughout some genera and characterizes many species. This is a character easily seen in herbarium material and present in the vegetative condition. It was first made use of and defined by Rydberg[27] and has proved of great value.

Pubescence is relatively rare in this group but when present is an excellent diagnostic character. Examples of its occurrence are the hirtellous condition of the foliage of *Cymopterus cinerarius*, the multicellular pubescence on the tips of the fruit of *C. deserticola* and *C. megacephalus*, the scaly tomentum of the commissural surface of the carpel of *C. deserticola*, the hirtellous pubescence at the base of the umbel in *Pseudocymopterus montanus*, and the tomentose lower leaf surface of *Glehnia leiocarpa*. *Phellopterus montanus* exhibits a peculiar foliage condition somewhat resembling pubescence. The epidermal layer of the leaves has become very irregular, giving the leaf surface an uneven and roughened appearance; moreover, the leaf margins and veins develop a subcartilaginous denticulation. The genus *Harbouria* exhibits a definite tuberculation of the fruit.

The roots are mostly tuberous. Occasionally a bulbous condition occurs. The general habit is of some value, particularly in a superficial determination of the genus—the variation ranging from prostrate, solitary, acaulescent plants through prostrate-

[27] Rydberg, Fl. Rocky Mts. 607. 1917.

caespitose to a tall, erect, caulescent condition—a specific character of value.

Summary

1. The comparative morphology of the group of genera studied is discussed, stressing the gross morphology of the genus *Cymopterus*.

2. The generic and specific characters used by previous workers in a classification of the family are reviewed.

3. There is a detailed treatment of the following morphological characters used in classification, and an evaluation of these characters is made, based on the results of this study: habit of plant; type of root; pseudoscape development; leaf outline, texture, division and margin, outline and length/breadth ratio of the ultimate leaf segment; the correlation of peduncle length to leaf length; type, texture, venation, and dentation of the involucre and involucel; length of rays; flower color; presence or absence of stylopodium; persistence of carpophore and calyx; outline of carpel, compression of the mericarp, winging of the fruit, convolution and texture of wings, shape and dimensions of wing or rib in cross-section, number and position of oil tubes, vascular and strengthening tissue in the carpels.

Geographical Distribution

The genera included in this study occur indigenously throughout western North America from western Missouri to the Pacific Coast and from southern Canada to northern Mexico. One exception, *Glehnia littoralis*, is limited in distribution to eastern Asia, occurring along the coast from southern Siberia to Formosa and in Japan. The presence of the genus *Glehnia* on the western coast of North America and the eastern coast of Asia presents an interesting situation paralleled by many other genera. A more detailed discussion of the genus has been given in a previous paper.[28]

The genus *Cogswellia* has the widest area of distribution—the limits of its range coinciding with those for the entire group.

The genus *Cymopterus* has only a slightly more limited distribution and presents many interesting problems. *Cymopterus*

[28] Mathias, Ann. Mo. Bot. Gard. 15: 91–108. 1928.

acaulis (fig. 4), undoubtedly one of the oldest species in the genus, extends from western Minnesota to eastern Oregon and from central Saskatchewan to southern Colorado. The most

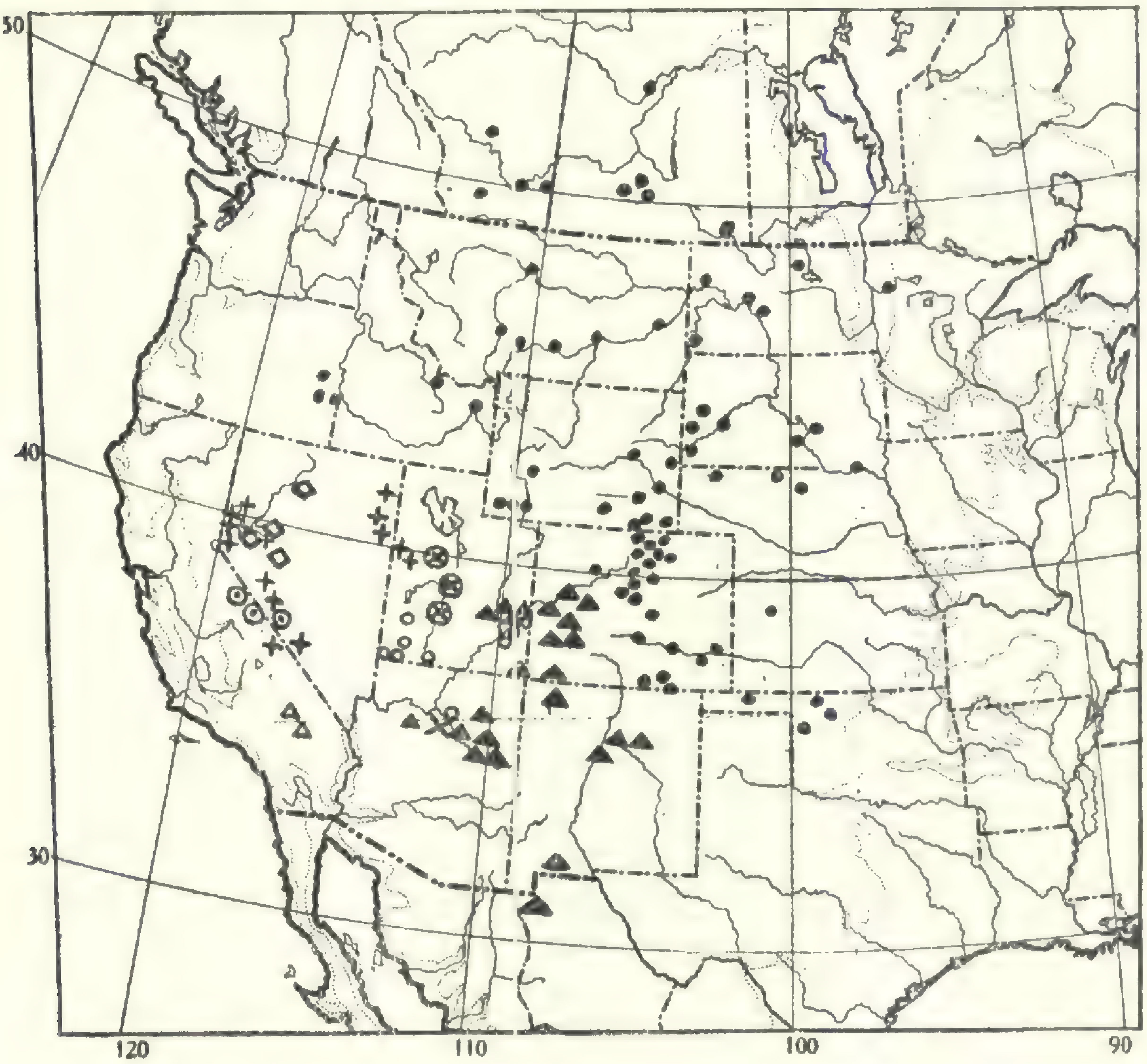

Fig. 4. Map of western North America showing the geographical distribution of the species of *Cymopterus*.

● ●	*C. acaulis*	⊗ ⊗	*C. Coulteri*
▲ ▲	*C. Fendleri*	◇ ◇	*C. corrugatus*
o o	*C. Newberryi*	×	*C. megacephalus*
+ +	*C. globosus*	△ △	*C. deserticola*
⊙ ⊙	*C. cinerarius*		

eastern station recorded is from a collection of Lapham in the "south bend of the Red River of Minnesota" [latitude 46°, longitude 96°] on the western boundary of that state. The most western station is in the Malheur Valley in eastern Oregon. The species also occurs in the Snake River plains of southern Idaho. It has doubtless passed across the mountains at some

break in the region of Yellowstone National Park. Since this species is probably of pre-glacial origin its distribution may best be explained as a northern, eastern and western expansion from the unglaciated areas of Colorado where it now occurs—a situation not improbable. Its nearest relative, *C. Fendleri*, occurs from west-central Colorado and eastern Utah to northern Mexico and from central New Mexico to west-central Arizona. *Cymopterus Newberryi* has a more limited range in east-central and southwest Utah. *Cymopterus globosus* has a somewhat comparable distribution in the state of Nevada as shown in the accompanying map (fig. 4). The other species of the genus are chiefly local—*C. deserticola* is known only from the Mohave Desert of California; its closest relative, *C. megacephalus*, occurs in the Little Colorado River Valley of Arizona. These two species are probable branches of one ancestral type common in the intervening area before the invasion of troughs during the early periods of the Cenozoic which separated large tracts of southern California and Arizona as islands. *Cymopterus cinerarius* is the only species found at higher altitudes, occurring at elevations from eight thousand to eleven thousand feet in the Mono National Forest region of eastern California and adjacent Nevada. At present its range is very limited but will doubtless be extended as a result of further explorations in that vicinity. *Cymopterus corrugatus* is known only from the Carson and Humboldt Lakes region in western Nevada, and *C. Coulteri* only from the valleys of the Sevier River and its tributaries in Utah.

The distribution of the other genera introduces a number of cases of local or at least very limited ranges. *Rhysopterus*, a monotypic genus as now defined, is known only from the Malheur Valley and adjacent regions in eastern Oregon (fig. 5). *Neoparrya* has been reported only from the type locality in northern New Mexico near Servilleta, Taos County (fig. 5). Other monotypic genera are *Podistera* and *Harbouria*. The former, an alpine representative of the group, is known only from the region of Mt. Dana in California and a collection from the San Bernardino Mountains (fig. 5). *Harbouria* is commonly distributed in the lower mountains from southeastern Wyoming to northern New Mexico (fig. 7).

Oreoxis is primarily an alpine and subalpine member of the group, represented most widely by *O. alpina* which occurs in the higher mountains throughout Colorado and extends westward to

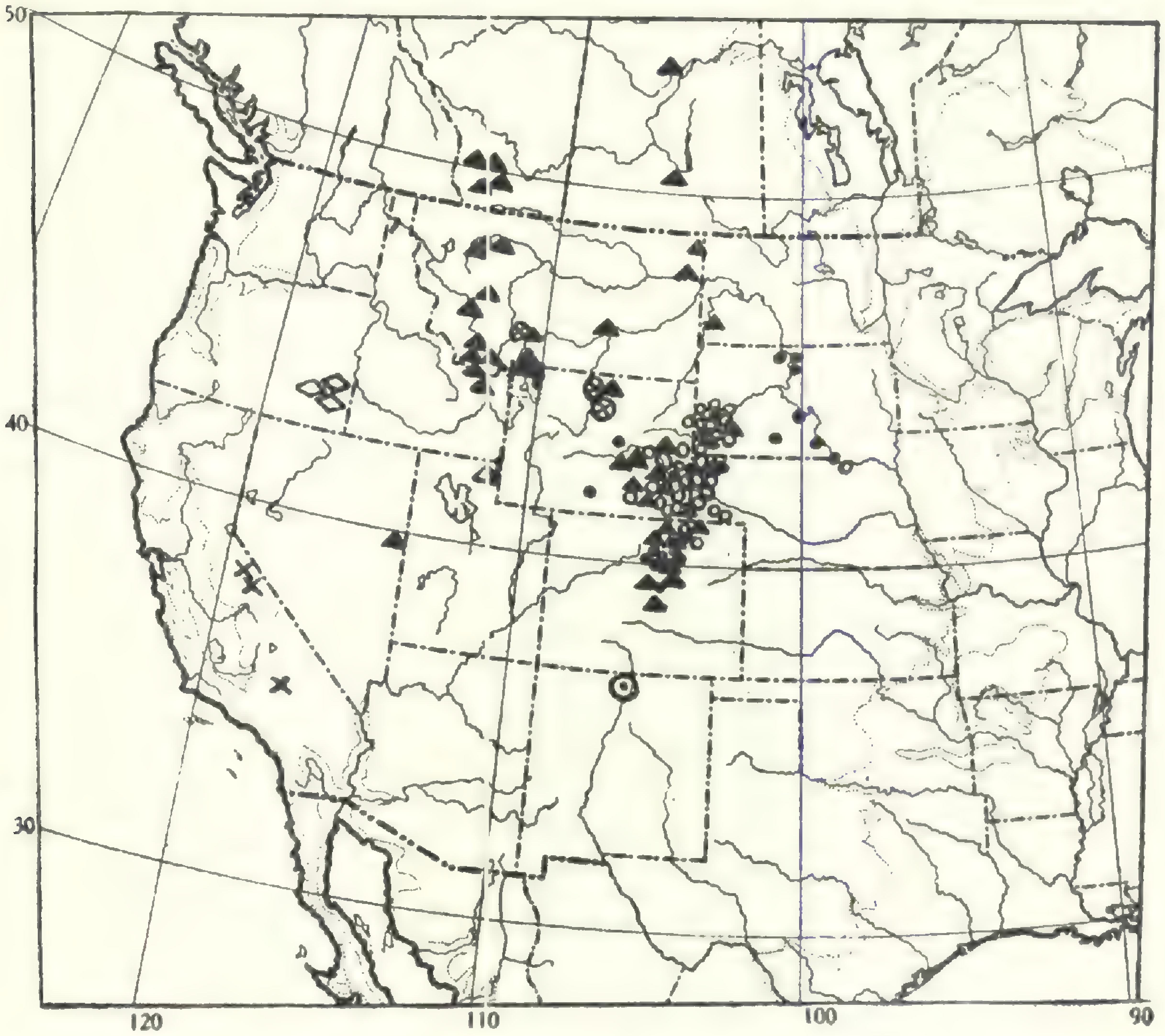

Fig. 5. Map of western North America showing the geographical distribution of the species of *Musineon*, *Neoparrya*, *Rhysopterus*, and *Podistera*.

● ● *Musineon divaricatum*	△ *M. lineare*
▲ ▲ *M. divaricatum* var. *Hookeri*	⊙ *Neoparrya lithophila*
○ ○ *M. tenuifolium*	◆ ◇ *Rhysopterus plurijugus*
⊗ ⊗ *M. vaginatum*	× × *Podistera nevadensis*

the Henry Mountains, Utah (fig. 8). *Oreoxis humilis*, on the other hand, is known only from the vicinity of Pike's Peak, Colorado, a region from which *O. alpina* has never been reported. *Oreoxis Bakeri* occurs primarily in southwestern Colorado and adjacent Utah and northern New Mexico. The only species of the genus found at lower elevations is *O. MacDougali* until recently known only from the type collection in the Grand Canyon of the Colorado, Arizona. Subsequent collections have

now given it a somewhat discontinuous range in the natural-bridge region of southeastern Utah and in Mesa Verde National Park, Colorado. In the latter locality it forms large colonies along the upper ledges of Spruce Canyon. Further collections in northeastern Arizona and adjacent regions, particularly on the mesas and in the canyons, will doubtless show this species to be common in that region.

The genus *Aletes*, represented by two species, *A. acaulis* and *A. humilis*, is best known by the former which extends from southern Wyoming in the lower mountains through central New Mexico to western Texas (fig. 7). *Aletes humilis* is at present known only from the region of Dale Creek, Larimer County, in northern Colorado.

The distribution of the genus *Musineon* parallels that of *Cymopterus acaulis*. *Musineon divaricatum* extends from the Missouri River in South Dakota to northwestern Montana, while its variety *Hookeri* is widespread from the western Dakotas to western Montana, with one collection from eastern Nevada, and from central Saskatchewan to central Colorado (fig. 5). The other species of the genus are more local in distribution; *M. tenuifolium* is common in southeastern Wyoming and adjacent regions; *M. vaginatum*, is known from the Bridger Mountains of southern Montana and the Big Horn Mountains of northern Wyoming; and *M. lineare* has been collected only in the type locality in Logan Canyon, Cache County, Utah.

The remaining genera of the group are among the best known and most widely distributed of western North American Umbelliferae. The genus *Phellopterus* is common from the plains of central Kansas and Nebraska west to eastern California (fig. 6). *Phellopterus montanus* and *P. macrorhizus* are the more eastern species of the genus; the former extends from central Kansas and Nebraska to western Wyoming and south to northern New Mexico; *P. macrorhizus* is limited to Texas, the only species of the group common in that state. *Phellopterus multinervatus* is the most southern representative of the genus, extending from western Texas to southeastern California; *P. purpurascens* has been reported from about the fortieth parallel in western Nevada and central Utah south to the Little Colorado River in Arizona;

P. bulbosus occupies a more or less narrow north and south belt west of the Rocky Mountains from southwestern Wyoming through Utah and Colorado to east-central Arizona but in the south extends east to Texas and then north to central Colorado,

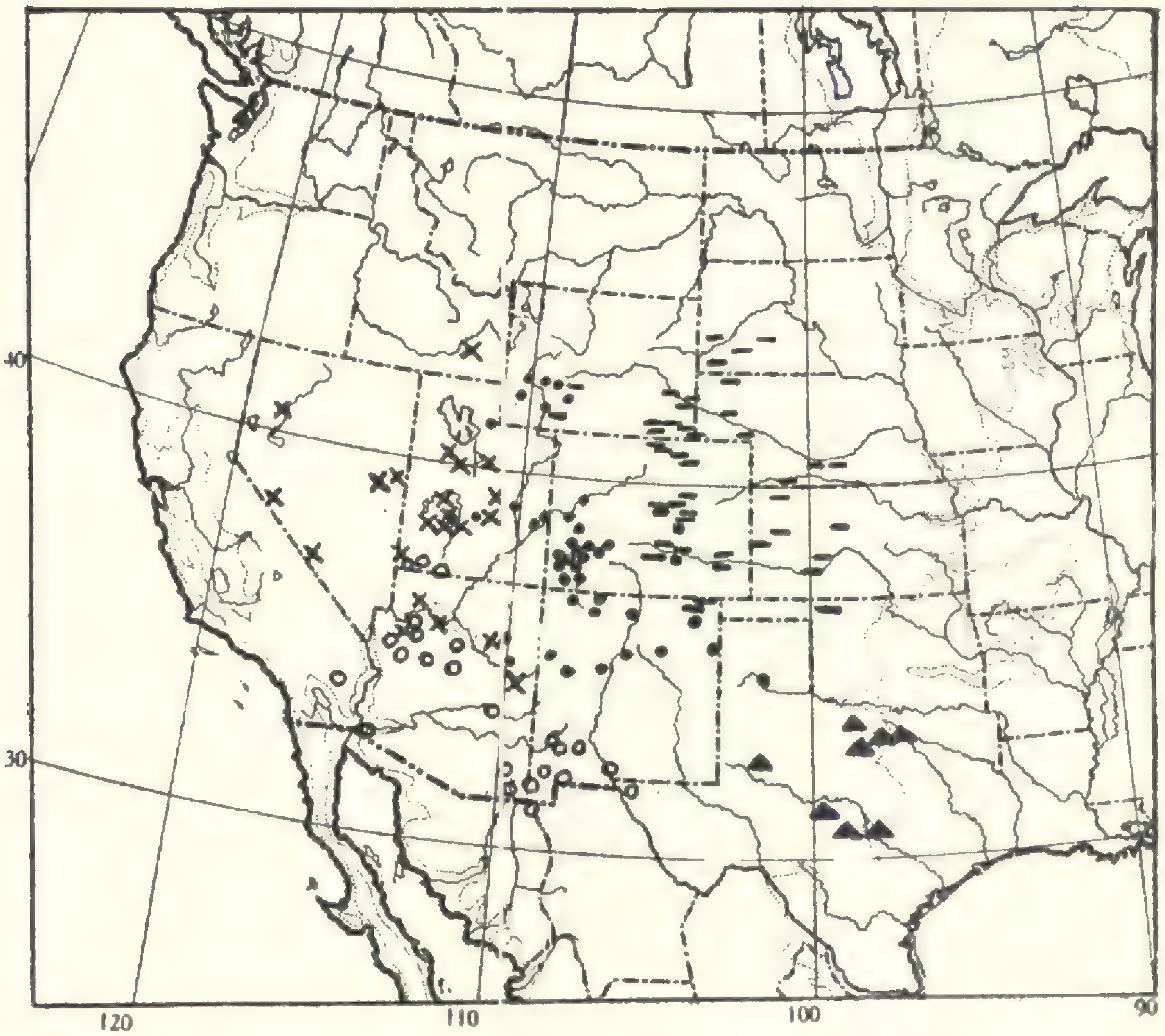

Fig. 6. Map of western North America, showing the geographical distribution of the species of *Phellopterus*.

— — *P. montanus*
▲▲ *P. macrorhizus*
ooo *P. multinervatus*
××× *P. purpurascens*
••• *P. bulbosus*

being reported from the vicinity of Colorado Springs. The comparatively recent collections of *P. bulbosus* east of the Rocky Mountains would indicate a recent migration across the Continental Divide in northern New Mexico and then a northern extension which may in time give the species a much wider distribution.

The genus *Aulospermum* is separable into two sections with distinct areas of distribution (fig. 7). The first section, the

more northern in range, is best represented by *A. longipes* which is limited to the northern Wahsatch Valley of Utah and adjacent Idaho, Wyoming, and Colorado. *Aulospermum*

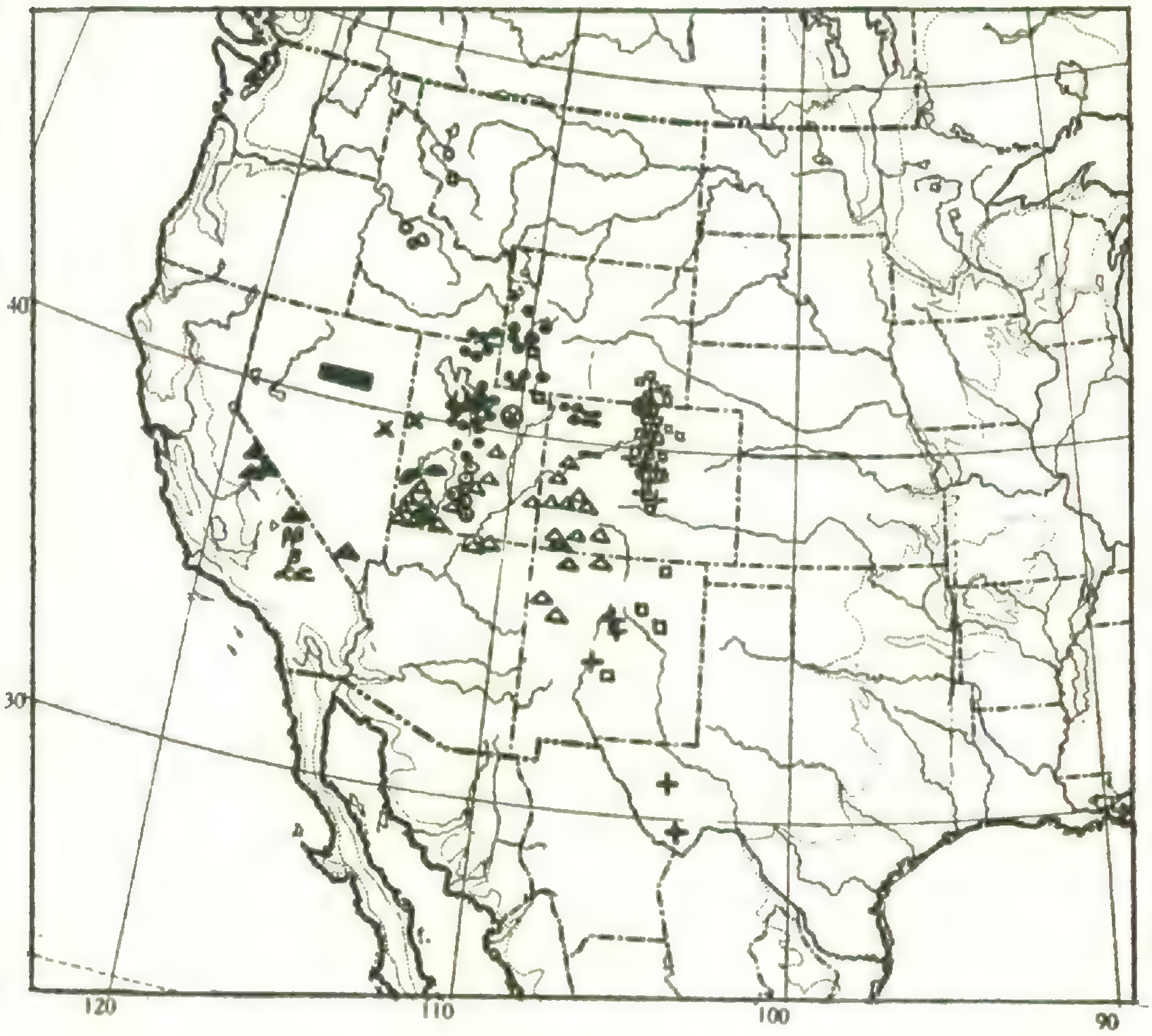

Fig. 7. Map of western North America, showing the geographical distribution of the species of *Aulospermum*, *Aletes*, and *Harbouria*.

- *Aulospermum longipes*
- *A. glaucum*
- *A. Watsoni*
- ××× *A. ibapense*
- *A. planosum*
- △△ *A. purpureum*
- *A. duchesnense*
- *A. Rosei*
- *A. minimum*
- *A. Jonesii*
- *A. aboriginum*
- β β *A. panamintense*
- ∝∝ *A. panamintense* var. *acutifolium*
- + + *Aletes acaulis*
- *A. humilis*
- *Harbouria trachypleura*

glaucum occupies a limited region from western Montana to central Idaho; *A. planosum* is known only from northwestern Colorado; *A. Watsoni* is limited to the original locality, "Battle and East Humboldt Mountains, Nevada," and the intervening area; and *A. ibapense* has been reported only in the fortieth

parallel region of western Utah and adjacent Nevada. The second section, is most widely represented by *A. purpureum* which extends from western Colorado and New Mexico to southwestern Utah; *A. Rosei* occupies a limited area in south-central Utah in the southern valley of the Sevier River and along its tributaries; *A. Jonesii* has been reported only from the region to the south of Sevier Lake, Utah; *A. duchesnense* is known solely from the type collection at Myton, Utah; and *A. minimum* has been collected only along the upper part of the "Breaks" formation, Cedar Breaks, Iron County, Utah. The remainder of the species are limited to California and western Nevada. *Aulospermum aboriginum* has been collected in the valley of Owen's River, California, and in the Charleston Mountains, Nevada; *A. panamintense* occurs in the Panamint and Argus Mountains, California, and its variety *acutifolium* in the Mohave Desert to the south.

Pteryxia is widespread in the region west of the Continental Divide, particularly in the northern Great Basin (fig. 8). *Pteryxia terebinthina*, the type of the genus, occurs commonly in the Walla Walla region of Washington and Oregon. Its variety *foeniculacea* extends east from that region to southeastern Idaho; the variety *californica* is limited to the mountains of northern California, extending from Siskiyou County south to the Yosemite region, and adjacent Nevada; variety *calcarea* is the most eastern representative of the genus, occurring from western Nevada north and east to southern Montana and central Wyoming; variety *albiflora* is more local in distribution, being known only from southern Montana and northern Wyoming in the region adjacent to Yellowstone National Park. This species, *P. terebinthina*, and its varieties may represent variations from one type which due to geographical isolation have developed distinctive characters. The prevalent intergradation of characters in the group would indicate a common and possible recent origin. *Pteryxia petraea* has a discontinuous distribution, comparable to that of some species of *Cymopterus*, in east-central California and western Nevada, southeastern Oregon and southern Idaho. However, collections from intermediate regions are few and such apparent discontinuity will probably lessen with the acquisition of more material.

The genus *Pseudocymopterus* is typically represented and most widely known by *P. montanus*, which has an extended range throughout the mountainous areas of the west, occurring from

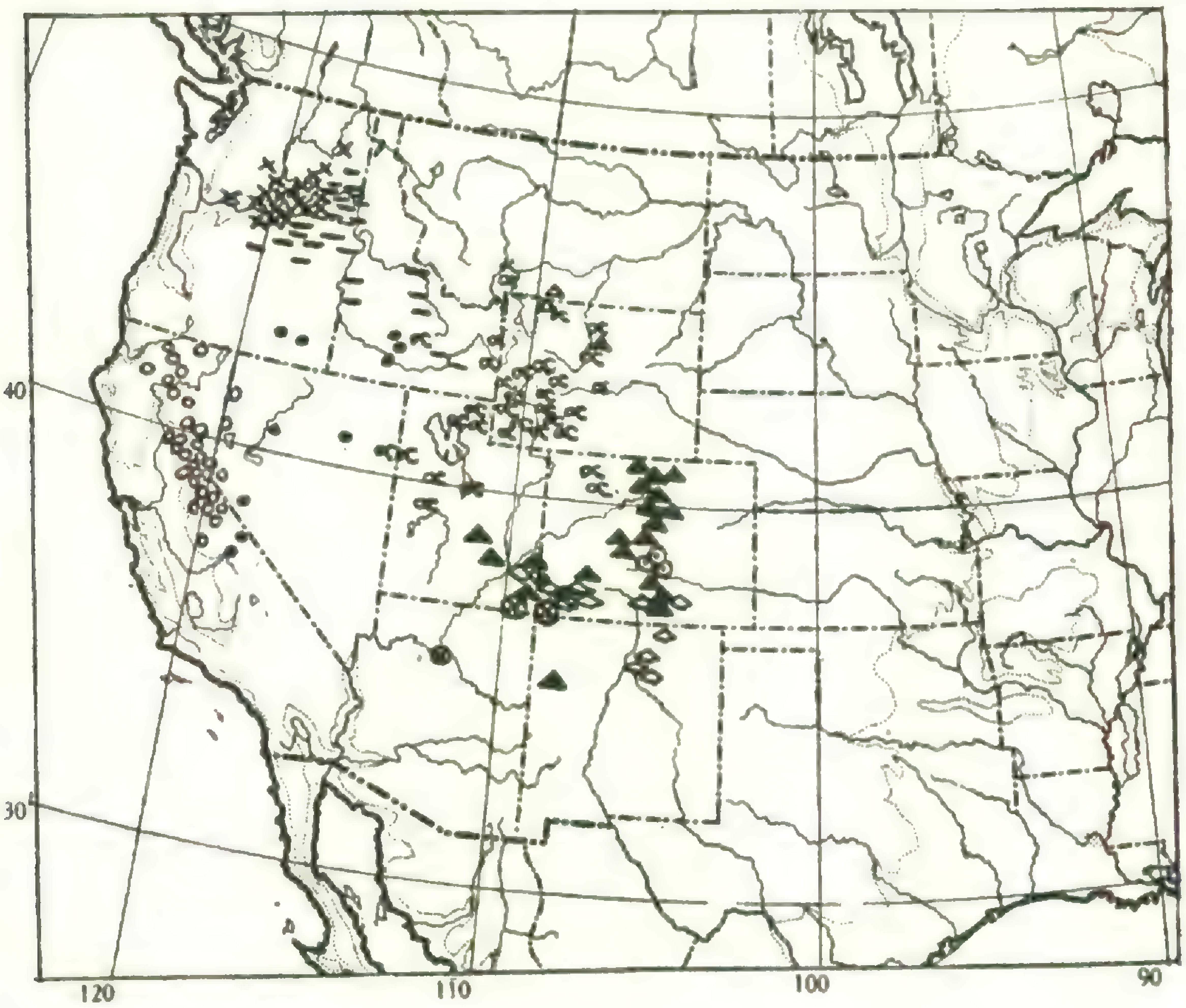

Fig. 8. Map of western North America, showing the geographical distribution of the species of *Pteryxia* and *Oreoxis*.

××× *Pteryxia terebinthina*
— — *P. terebinthina* var. *foeniculacea*
∝ ∝ *P. terebinthina* var. *calcarea*
○○○ *P. terebinthina* var. *californica*
△△△ *P. terebinthina* var. *albiflora*
●●● *P. petraea*
▲▲▲ *Oreoxis alpina*
⊕⊕⊕ *O. humilis*
◇◇ *O. Bakeri*
⊗⊗ *O. MacDougali*

southern Wyoming to Durango, Mexico, and from eastern New Mexico to western Utah (fig. 9). *Pseudocymopterus Hendersoni* (*P. anisatus* of authors) is also widely distributed in the western flora, extending from southern Idaho to northern New Mexico and from central Colorado to eastern Nevada. The remainder of the species are comparatively local in distribution; *P. anisatus* (*Pseudopteryxia aletifolia*) is limited to the region of El Paso Co., Colorado; *P. bipinnatus* covers a wider area in western Montana, Idaho, and eastern Oregon; *P. humboldtensis* and *P. nivalis* are

Fig. 9. Map of western North America, showing the geographical distribution of the species of *Pseudocymopterus*.

ooo *P. montanus*

▲▲ *P. Davidsoni*

××× *P. Hendersoni*

— — *P. bipinnatus*

◎ *P. humboldtensis*

◇ *P. nivalis*

●●● *P. anisatus*

known only from the East Humboldt Mountains of Nevada; while *P. Davidsoni* occurs in southwestern New Mexico in Grant County, and in adjacent Arizona.

The many monotypes now known only from limited areas and the numerous cases of limited distribution of species present complex but interesting distributional problems. Their distributions will doubtless be somewhat extended as the result of additional field studies and collections, and information will be available then for a more satisfactory explanation of the limiting factors. Climatic conditions, the presence of intervening mountain ranges, soil composition, etc. have here as in all cases limiting effects on distribution.

The present data would lead to the suggestion that these genera are for the most part nascent groups which are rapidly becoming more widespread in western North America, but that several species may represent remnants of older types which, due to changing geological conditions, have become isolated in certain regions and are, in some cases, gradually disappearing due to unfavorable growth conditions.

Generic and Specific Relationships

Drude[29] in Engler and Prantl's 'Natürlichen Pflanzenfamilien' has given the most recent comprehensive survey of the Umbelliferae. Accepting his sectional classification of the family, the genera involved in this study would fall in the tribes *Smyrnieae, Ammineae* and *Peucedaneae* of the section *Apioideae.*

The genus *Cymopterus* as interpreted by Torrey and Gray[30] consisted of a very polymorphous group of species, many of which showed relatively little in common with the generic type. The general tendency at present is to recognize these various morphological units as generically distinct from the *Cymopterus* of Rafinesque.[31] The following genera treated in this paper have been based partially or entirely on species originally placed in *Cymopterus—Rhysopterus, Podistera, Oreoxis, Aulospermum, Phellopterus, Glehnia, Pteryxia* and *Pseudocymopterus.*

[29] Drude, in Engler & Prantl, Nat. Pflanzenf. 3^8: 63–250. 1897–98.
[30] Torrey and Gray, Fl. N. Am. 1: 623. 1840.
[31] Rafinesque, Jour. Phys. 89: 100. 1819.

Jones[32] has treated the majority of these genera as constituting units of only sectional value and has divided the genus *Cymopterus* into seven sections.

The genus *Podistera* is not closely related to the other members of the group. Its original position under *Cymopterus* was an obvious error since the genus is characterized by the presence of a conical stylopodium, a character absent in all other Cymopteri. The other genera of the group are undoubtedly closely interrelated. They stand distinct from *Cogswellia*, on the one hand, and from *Musineon*, *Harbouria* and *Aletes*, on the other. However, the last four genera have been frequently involved in the *Cymopterus* complex and show a confusing intergradation in certain characters. Consequently they have been included in this study.

Cogswellia is separated from the *Cymopterus* type primarily by fruit characters. The fruit is conspicuously flattened dorsally and distinctly winged on the lateral ribs only. For the most part the plants are taller and caulescent in contrast to the low-growing acaulescent condition of *Cymopterus*. The two genera, *Cogswellia* and *Cymopterus*, are related through the species *Cymopterus Newberryi* in which there is a tendency toward abortion of dorsal wings resulting in a *Cogswellia* type of fruit. The genus *Cogswellia* has been treated only in a very preliminary manner in this paper. Because of the complexity of characters and the large size of the genus a more thorough treatment has been postponed until further field studies can be made.

The genus *Musineon* is characterized by the development of ribs instead of wings. *Harbouria* and *Aletes* also have ribbed fruits. The *Harbouria* fruit type is unique in this group, being only approached by the genus *Rhysopterus* which has similar broad corky ribs. *Musineon* and *Aletes* are related in fruit type through the species *A. acaulis* and *M. tenuifolium*.

Neoparrya represents a distinct type with oil tubes scattered throughout the pericarp, and practically no development of ribs. Its relationships to the group are probably closest to the genus *Aletes*.

The remaining genera, namely, *Cymopterus* and its segregates (excluding *Podistera*), are all characterized by the usual development of at least lateral wings.

[32] Jones, Contr. West. Bot. 12: 16–29. 1908.

Oreoxis is an alpine and subalpine type with the exception of *O. MacDougali*, which relates it to the genus *Aletes*. *Oreoxis Bakeri*, on the other hand, is suggestive of *Pseudocymopterus bipinnatus*.

The genera *Pteryxia* and *Pseudocymopterus* consist of groups of species in which intergradation is prevalent and pronounced, at times making the delimitation of species and the defining of generic elements difficult. The two genera are related through such species as *Pseudocymopterus humboldtensis* and *P. bipinnatus*. *Pteryxia* is related to *Cogswellia* through *P. terebinthina* var. *foeniculacea* and more especially through those elements of the variety in which the reduction of dorsal wings is most pronounced. *Pseudocymopterus* is related to *Cogswellia* through the forms of *P. montanus* with aborted dorsal wings. *Pseudocymopterus anisatus* (*Pseudopteryxia aletifolia*) in fruit and foliage characters suggests *Aletes*. *Pseudocymopterus Davidsoni* in fruit characters approaches the genus *Musineon*.

Aulospermum, one of the larger genera, is intermediate between the *Pteryxia-Pseudocymopterus* group and the *Phellopterus-Cymopterus* association. In *Aulospermum longipes* as in *Pseudocymopterus montanus* there is a tendency toward the reduction of dorsal wings resulting in a *Cogswellia* type of fruit.

The genus *Phellopterus*, through *P. montanus*, is connected with *Cymopterus* and *Glehnia*. However, it is readily separated from the other genera by the constant presence of scarious involucre and involucel bracts.

Glehnia is a littoral genus growing prostrate on the sands along the northwest coast of this country and in eastern Asia. Habitally, it is the most distinct genus of the group. It is characterized by broad leaf-divisions, a thick coriaceous leaf texture and prominent wing development of the fruit. The North American species, *G. leiocarpa*, has a densely tomentose lower leaf surface which alone distinguishes this species from others of this group.

The accompanying chart (fig. 10) indicates the probable generic relationships and the connecting species. As may be seen there are four focal points, the most pronounced of which is the genus *Pseudocymopterus*. The other centers are *Aulospermum*, *Cymopterus* and *Cogswellia*.

The genus *Cymopterus* is for the most part a low-growing, acaulescent or subcaulescent perennial, usually characterized by the presence of a dimidiate, foliaceous involucel, and is the only genus containing discoid inflorescence types. Within the genus there are apparently two lines of development revolving around *C. acaulis*—the one a tendency toward the development of a discoid inflorescence, the other a reverse tendency toward a spreading inflorescence type. The primitive condition within the genus is probably that exhibited by *Cymopterus acaulis*. In

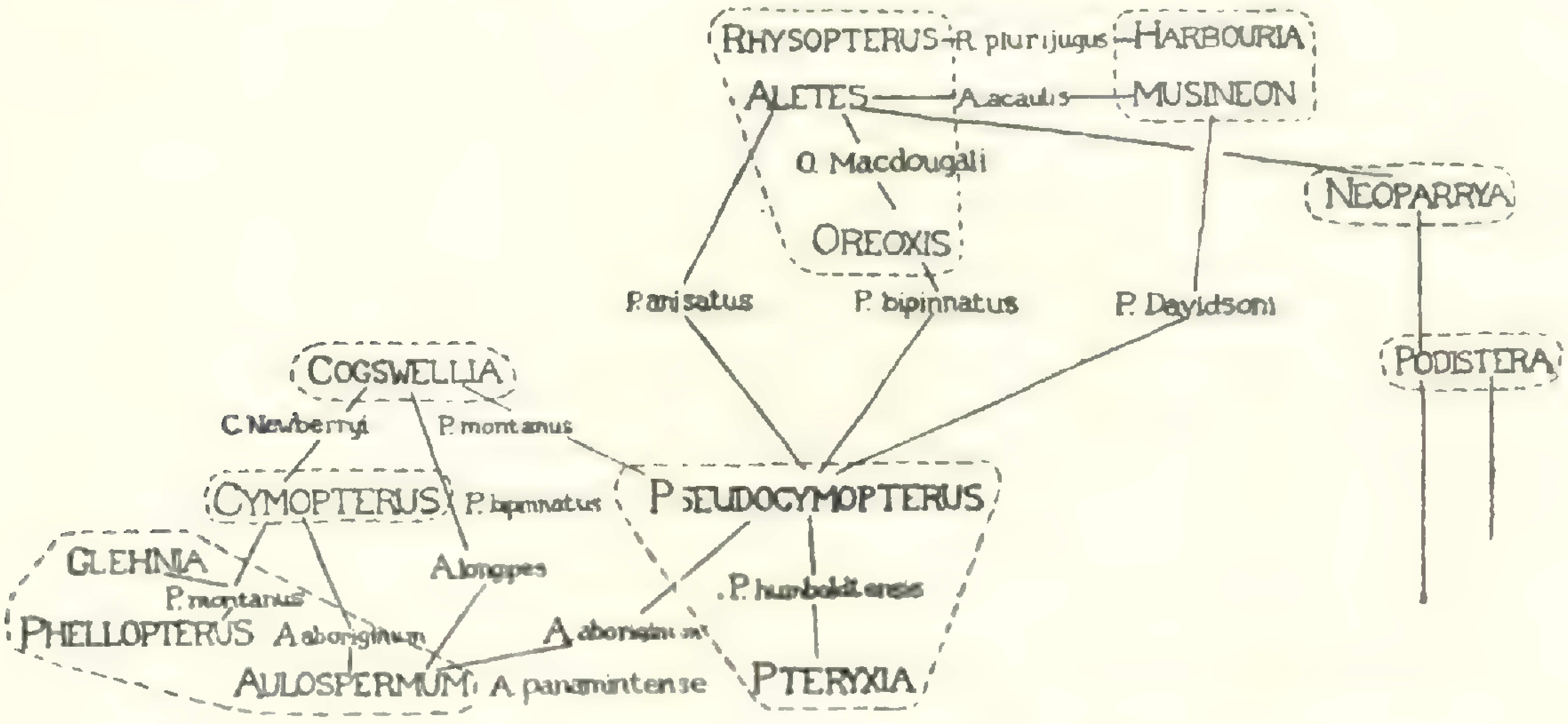

Fig. 10. Chart showing the probable relationship of the various genera.

addition to having an unusually wide range of distribution this species shows morphological characters which seem to indicate its primitive nature—the development of conspicuous lateral and dorsal wings and numerous oil tubes. The discoid inflorescence type, represented by four species, is a terminal group in which the extreme reduction of the umbel culminates in the species *C. globosus*, with the oil tubes reduced to a minimum of one in each interval. The relationship of these various species is shown in the purely hypothetical arrangement in the accompanying chart (fig. 11). The second development from the *C. acaulis* type culminates in the species *C. Fendleri* and *C. Newberryi*, with a tendency toward a widely spreading inflorescence and in the latter species toward the reduction of dorsal wings. *Cymopterus corrugatus* and *C. Coulteri* represent a lateral development, intermediate between the *C. globosus* and *C. Fendleri* groups, in which the umbel is only

slightly spreading and the number of oil tubes has been reduced to one in the intervals. Both species are relatively local in distribution and are probably remnants of extinct types.

The relationship of *Cymopterus* with its various segregates is through the spreading inflorescence type of *C. Fendleri* and *C. Newberryi.* The accompanying chart (fig. 10) illustrates a probable relationship between the various genera. The genera

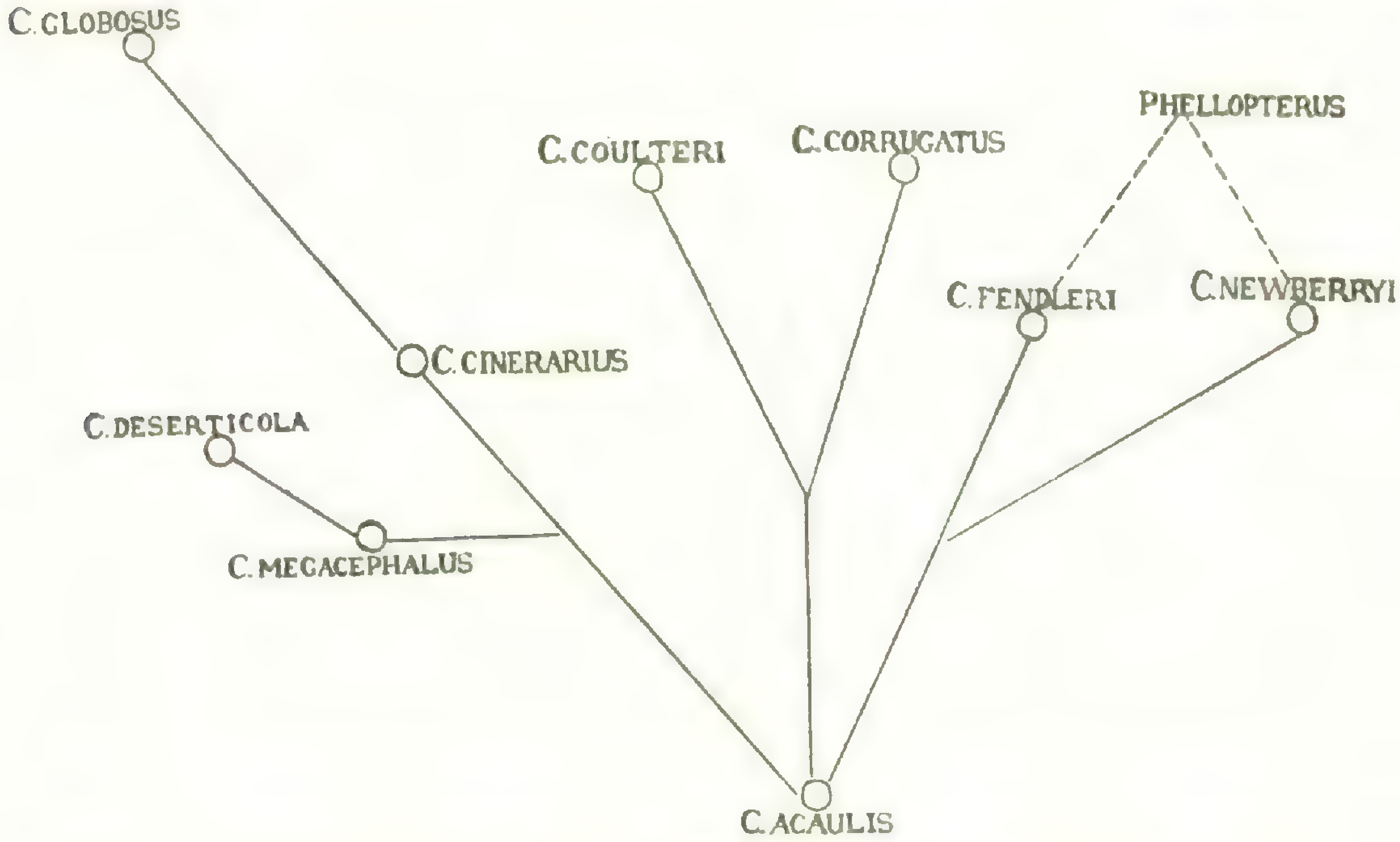

Fig. 11. Chart showing the present relationship of the species of *Cymopterus.*

Podistera and *Neoparrya* are probable offshoots from generic types removed from the *Cogswellia-Cymopterus* complex. It must be recognized that in a group of such complex morphological characters it is impossible to determine any definite lines of development or trace the genera back to possible ancestors. The question as to what constitutes the primitive morphological condition is one worthy of much discussion, and one which can not be answered with the material at hand. Since the fruit characters are of prime importance in classification and of comparative stability they constitute a valuable basis for a phylogenetic scheme of the genera. Two viewpoints may be taken concerning the primitive fruit condition—namely, a fruit with conspicuous wing development may be more primitive than one with ribs which are nothing more than reduced wings,

or, on the other hand, the ribbed condition may be the more primitive and the winged fruit represent a distinct advance showing an adaptation to environment and dissemination. However, fruit characters alone can not form a complete basis for a phylogenetic arrangement of the genera and in this study the accompanying hypothetical scheme is based on the results derived from a study of a combination of many characters. It illustrates primarily the relationship exhibited by the genera at present and not their relation to probable ancestral types.

Economic Uses

The Umbelliferae as a family contains many plants of economic importance. Their uses are variable; many of them are well-known vegetables such as carrot, parsley, parsnip, and celery; others are widely used in medicine; and others are known as condiments, for example, caraway, dill, coriander, and anise.

In this group of the family the economic importance of the plants has been little recognized. The Indians of western North America used many of the roots as food and mention is made of the fleshy roots in many of the early reports of western explorations. Rosenthal,[33] speaking of *Cymopterus glomeratus* (*C. acaulis*), reports the root as a favorite food of the Pawnee Indians. *Cymopterus Fendleri* was mentioned by Thurber[34] as the "Chimaja of the Mexicans at Santa Fe & by them used to flavor meats and make bitters for liquors." Torrey[35] mentions the use of *Cymopterus montanus* (*Phellopterus montanus*) by the Mexicans of the southwest who call it the "Gamote" or "Camote." Bois[36] refers also to this plant with its fusiform roots somewhat resembling the parsnip but more tender and sweeter. *Phellopterus littoralis* (*Glehnia littoralis*) is cultivated in Japan and used as a condiment.[37]

Finnemore[38] reports Brandel's work in which he found that from the entire plant of *Pseudocymopterus anisatus* (*P. Hendersoni* as here defined) there could be obtained 4 cc. of an oil, with an

[33] Rosenthal, Synopsis plantarum diaphoricarum, 551. 1862.

[34] Thurber collection from New Mexico, 1851 (Herbarium of the Field Museum of Natural History No. 306405).

[35] Torrey, Bot. Whipple's Exp. 36 [92]. 1857.

[36] Bois, Les plantes alimentaires. Encyc. Biol. 1: 247. 1927.

[37] *Ibid.* 1: 246. 1927.

[38] Finnemore, The essential oils, 684–685. 1926.

odor resembling anise and a specific gravity at 20° C. of 0.978, which did not freeze on cooling and might contain methyl chavicol.

Upon cultivation this group might become one of some economic value either as a food or in the production of oils.

Key to the Genera

The following is an artificial key to the genera included in this study. No attempt is made to place them in a supposed natural sequence or relationship in the key, since that would involve to some extent the use of microscopic fruit characters. On the contrary, the present key is based as far as possible on vegetative characters obvious even in the flowering stage. When fruit characters are used they are mostly of such a nature that they can not only be determined from a superficial examination of fruiting specimens but also from the immature ovary in the flowering stage.

A. Stylopodium present; alpine plants known only from the mountains of California.. *I. Podistera*
AA. Stylopodium absent.
  B. Fruit not distinctly winged laterally or with well-developed or obsolete ribs.
    C. Plants acaulescent.
      E. Pseudoscape absent.
        I. Ultimate segments of the leaves appearing as lobes of an obovate to cuneate leaflet.
          M. Rays of the umbel subequal...................... *VI. Aletes*
          MM. Rays of the umbel conspicuously unequal .... *IX. Pseudocymopterus*
        II. Ultimate segments of the leaves distinct, linear.
          N. Rays of the umbel reflexed or widely spreading in the fruiting stage............................. *V. Neoparrya*
          NN. Rays of the umbel not reflexed nor widely spreading in the fruiting stage.......................... *II. Musineon*
      EE. Pseudoscape present................................ *IV. Rhysopterus*
    CC. Plants caulescent.
      F. Stems few-leaved.
        J. Fruit ovate, conspicuously constricted at the commissure, carpels appearing nearly distinct........................ *III. Harbouria*
        JJ. Fruit ovate to oblong, not constricted at the commissure, carpels not appearing distinct........................... *II. Musineon*
      FF. Stems many-leaved............................ *IX. Pseudocymopterus*
  BB. Fruit distinctly winged laterally.
    D. Dorsal wings of the fruit absent or much-reduced.
      G. Inflorescence discoid............................ *XIV. Cymopterus*

GG. Inflorescence not discoid.
K. Involucel conspicuously dimidiate and foliaceous.
O. Pseudoscape absent .... *XIV. Cymopterus*
OO. Pseudoscape present .... *VIII. Cogswellia*
KK. Involucel neither conspicuously dimidiate nor foliaceous.
P. Pseudoscape present .... *XI. Aulospermum*
PP. Pseudoscape absent.
S. Peduncles hirtellous-pubescent only at the base of the umbel .... *IX. Pseudocymopterus*
SS. Peduncles glabrous or puberulent throughout. .... *VIII. Cogswellia*
DD. Dorsal wings of the fruit present.
H. Leaf divisions narrow, mostly less than 0.5 cm. wide; plants not maritime.
L. Bracts of the involucre, when present, and involucel not definitely scarious.
Q. Peduncles usually exceeding the leaves; inflorescence not definitely globose.
T. Plants caulescent.
U. Peduncle hirtellous-pubescent at the base of the umbel .... *IX. Pseudocymopterus*
UU. Peduncle entirely glabrous .... *X. Pteryxia*
TT. Plants acaulescent, or subcaulescent with the development of a pseudoscape.
V. Peduncles variously pubescent at the base of the umbel.
W. Plants mostly over 1 dm. in height; leaves ovate-oblong to broadly ovate in general outline.
Y. Rays of the umbel comparatively short; fruit 3–7 mm. long, 2–4 mm. broad. .... *IX. Pseudocymopterus*
YY. Rays of the umbel longer, up to 90 mm. in length; fruit 6–12 mm. long, 5–10 mm. broad .... *XI. Aulospermum*
WW. Plants usually lower; leaves oblong to ovate-oblong in general outline.
Z. Ultimate divisions of the leaves mostly confluent; fruit 4–10 mm. long, 3–7 mm. broad, wings well developed . *XI. Aulospermum*
ZZ. Ultimate divisions of the leaves mostly distinct; fruit 3–6 mm. long, 1.5–4 mm. broad, wings short .... *VII. Oreoxis*
VV. Peduncles glabrous at the base of the umbel.
X. Pseudoscape absent or inconspicuous.
a. Leaves oblong in general outline, conspicuously longer than broad.
c. Leaves pubescent.
e. Leaves mostly quadripinnatisect; pe-

duncles 8–30 cm. long; rays of the umbel 4–20 mm. long. . . . . *XI. Aulospermum*

ee. Leaves simply or bi-pinnatisect; peduncles 4–10 cm. long; rays of the umbel less than 5 mm. long. . . . . . *IX. Pseudocymopterus*

cc. Leaves essentially glabrous.

f. Leaves bi–tri-pinnatisect, ultimate segments linear, mostly distinct. . . . . *IX. Pseudocymopterus.*

ff. Leaves mostly simply pinnate (when bipinnatisect the ultimate segments confluent, appearing as lobes of a cuneate to obovate leaflet). . . . . *VII. Oreoxis*

aa. Leaves ovate-oblong and broadly ovate to oblong-obovate in general outline, not conspicuously longer than broad.

d. Mature plants less than 1 dm. in height.

g. Umbel compact, subglobose, rays subequal. . . . . *XIV. Cymopterus*

gg. Umbel more spreading, rays unequal.

i. Involucel conspicuously dimidiate and foliaceous. . . . . *XIV. Cymopterus*

ii. Involucel not conspicuously dimidiate nor foliaceous. . . . . *XI. Aulospermum*

dd. Mature plants over 1 dm. in height.

h. Involucre present, in the form of a low sheath or of distinct bracts . . . . *XIV. Cymopterus*

hh. Involucre absent.

j. Peduncles mostly shorter than the leaves; rays of the umbel less than 10 mm. long; wings of the fruit conspicuously narrow at the base in cross-section. . . . . *XIV. Cymopterus*

jj. Peduncles exceeding the leaves; rays of the umbel mostly over 10 mm. in length; wings of the fruit not conspicuously narrow at the base in cross-section.

k. Involucel bracts inconspicuous, linear, lance-attenuate; plants occurring mostly north of the fortieth parallel. . . . . *X. Pteryxia*

kk. Involucel bracts more conspicuous (rarely aborted in some umbellets), usually dimidiate, linear to triangular, acute to acuminate; plants occurring mostly south of the fortieth parallel. . . . . *XI. Aulospermum*

XX. Pseudoscape conspicuous.
b. Pseudoscape long; involucel bracts mostly inconspicuous, not green.....*XI. Aulospermum*
bb. Pseudoscape short; involucel bracts usually conspicuous, green...........*XIV. Cymopterus*
QQ. Peduncles usually not exceeding the leaves; inflorescence globose.....................*XIV. Cymopterus*
LL. Bracts of the involucre, when present, and involucel definitely scarious.
R. Leaves rough-puberulent..........*IX. Pseudocymopterus*
RR. Leaves not rough-puberulent........*XII. Phellopterus*
HH. Leaf divisions broad, 0.5–3 cm. wide; plants maritime..*XIII. Glehnia*

Review of Related Genera

I

PODISTERA Wats.

Podistera Wats. Proc. Am. Acad. **22**: 475. 1887; Coult. & Rose, Rev. N. Am. Umbell. 24, 108. 1888; Engler & Prantl, Nat. Pflanzenf. 3[8]: 207. 1898; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 125. 1900; Jeps. Madroño **1**: 139. 1923; Man. Fl. Pl. Calif. 714. 1925.

Low, caespitose, herbaceous, acaulescent, scabrous perennials with long, thickened roots. Leaves thin, pinnate to bipinnate; ultimate leaf divisions 1–3 mm. long, about 1 mm. wide, petioles sheathing. Inflorescence subcompact, peduncles exceeding the leaves; involucre absent; involucel conspicuous, dimidiate, foliaceous, subscarious; calyx teeth prominent; flowers white or pinkish; stylopodium subconical. Fruit ovate-oblong, flattened dorsally; wings obsolete; oil tubes small, numerous on the lateral and dorsal surfaces, 4–6 on the commissural side.

Type species: **Podistera nevadensis** (Gray) Wats. Proc. Am. Acad. **22**: 475. 1887.

1. Podistera nevadensis (Gray) Wats. Proc. Am. Acad. **22**: 475. 1887; Coult. & Rose, Rev. N. Am. Umbell. 108. 1888; Contr. U. S. Nat. Herb. **7**: 125. 1900; Hall & Hall, Yosemite Flora, 171. 1912; Smiley, Univ. Calif. Publ. Bot. **9**: 281. 1921 [Fl. Sierra Nev. Calif.]; Jeps. Madroño **1**: 140. 1923; Man. Fl. Pl. Calif. 714. 1925. Pl. 22, fig. 1.

Cymopterus ? nevadensis Gray, Proc. Am. Acad. **6**: 536. 1865.

Podistera albensis Jeps. Madroño **1**: 140. 1923; Man. Fl. Pl. Calif. 714. 1925.

Plants about 1–5 cm. high; leaves narrowly oblong in general outline, excluding the petiole, 3–6 mm. long, 1–3 mm. broad, ultimate segments apiculate, distinct, 1–3 mm. long, about 1 mm. broad, petiole expanded, 3–6 mm. long; peduncles solitary, 1–2.5 cm. long, umbels few-rayed, rays usually obsolete, involucel bracts conspicuous (often by reduction of the rays forming a false involucre), equalling or exceeding the flowers, occasionally scarious-margined, linear, acute at the apex; fruit 1–2 mm. long, about 1 mm. broad; oil tubes 12–16 on the dorsal and lateral surfaces, disposed in the intervals, 4–6 on the commissural surface.

Type specimen: *Brewer*, "at and near the summit of Mt. Dana," California, 1863. (TYPE in the Gray Herbarium of Harvard University).

Distribution: in the high mountains of eastern California centering in the region of Mt. Dana.

Specimens examined:

CALIFORNIA: top of Mt. Dana, 13,227 ft. alt., June 1863, *Brewer 1739* (G[39] TYPE); at and near the top of Mt. Dana, 3900 m. alt., June 1863, *Brewer 2717* (G TYPE); Mt. Gibbs, Yosemite National Park, 23 July 1919, *Mrs. J. Clemens* (CAS); Mt. Dana, 27 Aug. 1895, *Congdon* (D 28678, 129634); Mono Pass, Yosemite National Park, 21 Aug. 1907, *Eastwood 548* (CAS, D, NY, US); summit, gravel between pines, Sugarloaf, San Bernardino Mts., 9800 ft. alt., 11 July 1906, *Grinnell & Grinnell 214* (CAS); alpine zone, Mt. Dana, 11,750–13,000 ft. alt., July 1902, *Hall & Babcock 3607* (C, M, NY, US); near summit of Mt. Dana, 13,000 ft. alt., Sept. 1877, *J. G. Lemmon* (US); Mt. Dana, Aug. 1878, *J. G. Lemmon 1424* (G); on the south slope of Mt. Dana, 11,000–12,000 ft. alt., Aug. 1878, Sept. 1897, 1898, *Lemmon & Lemmon* (D 28679, US 303733).

This genus is known only from the mountains of California and especially from the region of Mt. Dana. However, the collection by Grinnell from the San Bernardino Mountains indicates its occurrence in other parts of the state, and future collections will doubtless extend the range in the higher mountains of southern

[39] A list of abbreviations is given on page 407.

California. It is the only genus in the group possessing a well-marked conical stylopodium. The species is a low-growing alpine plant, definitely acaulescent and caespitose.

II

MUSINEON Raf.

Nuttall[40] in 'Fraser's Catalogue' in 1813 listed a *Seseli lucidum* ("78. *Seseli lucidum. ‡ M.") as a new species from the Missouri but unfortunately gave no description, other than a mention of its perennial nature. Pursh[41] in the following year described one of the Bradbury collections from "upper Louisiana" ("Missouri Bluffs, at the mouth of the L'eau qui Court"[42] [Niobrara River, South Dakota]) as a new species, naming it *Seseli divaricatum*. Nuttall[43] in his 'Genera' recognized the relationship of his *S. lucidum* to *S. divaricatum* Pursh and treated the two as conspecific. In 1819 in Journal de Physique' Rafinesque[44] described the genus *Marathrum* saying: "Le type de ce genre est le *Seseli divaricatum* de Pursh et Nuttall." However, Humboldt and Bonpland,[45] eleven years previous, had described a valid genus *Marathrum* in the Podostemonaceae, and Rafinesque[46] recognizing this duplication of names proposed, in the 'Journal de Physique' for the year 1820, the name *Musineon* for his *Marathrum* ("Mon G. *marathrum* devra se nommer *musineon*."). Five years later, in his 'Neogenyton,' Rafinesque[47] apparently overlooked this proposal and offered the name *Adorium* ("Substituted to my *Marathrum*, 1819"). Nuttall used the name *Musenium* on his herbarium labels for the same group of plants but it was doubtless meant as a Latinization of the Rafinesquian name. Unfortunately, it was taken up by Torrey and Gray[48] in their 'Flora of North America,' thereby greatly confusing the terminology. The name *Musineon* as the oldest tenable name

[40] Nuttall, Fras. Cat. 1813 [reprinted in Pittonia 2: 118. 1890].
[41] Pursh, Fl. Am. Sept. 2: 732. 1814.
[42] Bradbury, Cat. 1819 [reprinted in Thwaite, Early West. Trav. 5: 318. 1904].
[43] Nuttall, Gen. 1: 194. 1818.
[44] Rafinesque, Jour. Phys. 89: 101. 1819.
[45] Humboldt and Bonpland, Pl. Aequin. 1: 39, *t. 11*. 1808.
[46] Rafinesque, Jour. Phys. 91: 71. 1820.
[47] Rafinesque, Neogenyt. 3. 1825.
[48] Torrey and Gray, Fl. N. Am. 1: 642. 1840.

must be adopted as the correct one for the genus. It is taken as the correct generic name, even though it is not the Latin form, in order to retain the original spelling (Art. 57 of the International Rules of Botanical Nomenclature).

Musineon Raf. Jour. Phys. **91**: 71. 1820; Coult. & Rose, Bot. Gaz. **20**: 259. 1895; Britt. & Brown, Ill. Fl. **2**: 527. 1897, and ed. 2. **2**: 643. 1913; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 76. 1900; Britt. Man. 677. 1901, and ed. 2. 677. 1905; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 349. 1909; Daniels, Fl. Boulder, Col. 183. 1911; Petersen, Fl. Nebr. 161. 1912; Lunell, Am. Midl. Nat. **4**: 485. 1916 (Enum. Pl. Dak. 8: 117); Rydb. Fl. Rocky Mts. 615. 1917, and ed. 2. 615. 1922.

Marathrum Raf. Jour. Phys. **89**: 101. 1819, non *Marathrum* Humboldt & Bonpland, Pl. Aequin. **1**: 39, *t. 11*. 1808.

Adorium Raf. Neogenyt. 3. 1825; Kuntze, Rev. Gen. Pl. **1**: 264. 1891; Britt. Mem. Torr. Bot. Club **5**: 242. 1894.

Musenium Nutt. in Torr. & Gray, Fl. N. Am. **1**: 642. 1840; Walp. Rep. Bot. Syst. **2**: 427. 1843; Benth. & Hook. Gen. Pl. **1**: 884. 1867; Port. & Coult. Syn. Fl. Col. 51. 1874; Wats. Bibl. Ind. **1**: 426. 1878; Coult. Man. Bot. Rocky Mt. 114. 1885; Coult. & Rose, Rev. N. Am. Umbell. 24, 110. 1888; Webber, Cat. Fl. Nebr. 124. 1890; Howell, Fl. N. W. Am. **1**: 265. 1898.

"*Musineum* Raf." acc. to Engler & Prantl, Nat. Pflanzenf. **3**[8]: 168. 1898; Clem. & Clem. Rocky Mt. Fl. 231. 1914.

"*Musenion* Raf." acc. to Heller, Cat. N. Am. Pl. 97. 1898, and ed. 2. 149. 1900; Rydb. Fl. Col. 253. 1906.

Daucophyllum (Nutt.) Rydb. Bull. Torr. Bot. Club **40**: 68. 1913; Rydb. Fl. Rocky Mts. 615. 1917, and ed. 2. 615. 1922.

Low, herbaceous, caulescent or acaulescent, glabrous or scabrous perennials with long, thickened, subfusiform taproots. Leaves petiolate, thin, simply pinnate to tripinnatisect or ternate; ultimate leaf divisions distinct to confluent, narrowly to broadly linear; petioles somewhat sheathing. Inflorescence compact, peduncles shorter than or exceeding the leaves; involucre mostly absent; involucel bracts dimidiate, mostly distinct, linear, acute, occasionally scarious-margined; calyx teeth conspicuous; flowers white or yellow; stylopodium lacking. Car-

pophore persistent, entire. Fruit ovate to linear-oblong, occasionally constricted at the apex, subterete in cross-section or flattened laterally, conspicuously 5-ribbed; oil tubes variable in size, 1–4 in the intervals, 2–6 on the commissural side, sometimes one in each rib; strengthening cells at the base of the rib usually absent; seed face plane or concave.

Type species: **Musineon divaricatum** (Pursh) Raf. Jour. Phys. **91:** 71. 1820.

KEY TO SPECIES

A. Plants caulescent.
B. Stems mostly dichotomously branching, pseudoscape usually developed
D. Stems and fruit mostly glabrous.................... *1. M. divaricatum*
DD. Stems mostly scabrous; fruit minutely scaberulent to densely scabrous........................ *1a. M. divaricatum* var. *Hookeri*
BB. Stems not dichotomously branching, pseudoscape not developed.
E. Petiole inflated at base into a conspicuous purplish, scarious-margined sheath; plants of Montana and northern Wyoming. .... *2. M. vaginatum*
EE. Petiole not conspicuously inflated, not purplish; plants of northern Utah... *3. M. lineare*
AA. Plants acaulescent.
C. Peduncle entirely glabrous; involucel conspicuous; plants of Utah. .... *3. M. lineare*
CC. Peduncle mostly hirtellous at the base of the umbel; involucel inconspicuous; plants of the plains and foothills of eastern Wyoming and adjacent states.............................. *4. M. tenuifolium*

1. M. divaricatum (Pursh) Raf. Jour. Phys. **91**: 71. 1820; Coult. & Rose, Bot. Gaz. **20**: 259. 1895. Pl. 26, fig. 1.

Seseli divaricatum Pursh, Fl. Am. Sept. **2**: 732. 1814, and ed. 2. **2**: 732. 1816; Bradbury, Cat. 1819 [reprinted in Thwaite, Early West. Trav. **5**: 318. 1904]; Spreng. in Linn. Syst. Veg., ed. Roem. & Schult., **6**: 406. 1820, in part; Linn. Syst. Veg., ed. Spreng., **1**: 886. 1825; DC. Prodr. **4**: 146. 1830, as to description; Eaton & Wright, N. Am. Bot. 423. 1840.

Marathrum divaricatum (Pursh) Raf. Jour. Phys. **89**: 101. 1819.

Adorium divaricatum (Pursh) Raf. Neogenyt. 3. 1825.

A. crassifolium Raf. in Seringe, Bull. Bot. **1**: 217. 1830; The Good Book **1**: 55. 1840.

Musenium divaricatum Nutt. in Torr. & Gray, Fl. N. Am. **1**: 642. 1840, in part; Walp. Rep. Bot. Syst. **2**: 427. 1843;

Wats. Bibl. Ind. **1**: 426. 1878, in part; Coult. Man. Bot. Rocky Mt. 114. 1885; Coult. & Rose, Rev. N. Am. Umbell. 110. 1888.

Adorium lucidum (Nutt.) Kuntze, Rev. Gen. Pl. **1**: 264. 1891, in part.

A. divaricatum (Pursh) Rydb. Bot. Surv. Nebr. 3: 37. 1894; Britt. Mem. Torr. Bot. Club **5**: 242. 1894, in part.

"*Musineon divaricatum* (Pursh) Nutt." acc. to Britt. & Brown, Ill. Fl. **2**: 527. 1897, and ed. 2. **2**: 643. 1913; Rydb. Mem. N. Y. Bot. Gard. **1**: 288. 1900; Britt. Man. 677. 1901, and ed. 2. 677. 1905; Petersen, Fl. Nebr. 161. 1912; Lunell, Am. Midl. Nat. **4**: 485. 1916 (Enum. Pl. Dak. 8: 117).

"*Musenion divaricatum* (Pursh) Nutt." acc. to Heller, Cat. N. Am. Pl. 97. 1898, and ed. 2. 149. 1900.

"*Musineon divaricatum* (Pursh) Coult. & Rose" acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 77. 1900; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 349. 1909; Daniels, Fl. Boulder, Col. 183. 1911; Nels. Spring Fl. Intermt. States, 114. 1912; Rydb. Fl. Rocky Mts. 615. 1917, and ed. 2. 615. 1922.

Musineon pedunculatum Nels. Bull. Torr. Bot. Club **28**: 225. 1901; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 349. 1909; Nels. Spring Fl. Intermt. States, 114. 1912; Rydb. Fl. Rocky Mts. 615. 1917, and ed. 2. 615. 1922.

"*Musenion divaricatum* (Pursh) Coult. & Rose" acc. to Rydb. Fl. Col. 253. 1906.

"*Musenium pedunculatum* Nels." acc. to Ind. Kew. Suppl. **3**: 116. 1908.

Plants caulescent, spreading to erect, 0.6–3.6 dm. high, usually with a conspicuous pseudoscape; stems glabrous to somewhat scaberulent, mostly dichotomously branching, usually longer than the leaves; leaves ovate-oblong in general outline, excluding the petiole, 1.5–9 cm. long, 1–8 cm. broad, bi–tri-pinnatisect, sometimes ternate-pinnatisect, ultimate segments mostly confluent, acute, sometimes mucronate, 1–4 mm. long, 1–2 mm. broad; petioles 1–13 cm. long; umbels 10–20-rayed, rays of each umbel subequal, 0.4–4.5 cm. long, glabrous or scaberulent; involucel dimidiate, bracts more or less distinct, linear-lanceolate, acute, sometimes scarious-margined, occasionally scaberulent, shorter than the yellow flowers; fruit ovate to oblong, constricted at the

apex, 3–6 mm. long, about 2 mm. broad, mostly glabrous, rarely minutely scaberulent; oil tubes 3–4 in the intervals, 4–6 on the commissure, sometimes one in each rib; seed face concave.

Type specimen: *Bradbury*, "In Upper Louisiana" ("Missouri Bluffs, at the mouth of the L'eau qui Court [Niobrara River, South Dakota]"), 1811 (TYPE probably in the Herbarium of the Royal Botanic Gardens, Kew, cotype in the Herbarium of the Academy of Natural Sciences, Philadelphia).

Distribution: northern Montana to central Colorado, Missouri River Valley of South Dakota and Nebraska west to western Wyoming and Montana.

Specimens examined:

SOUTH DAKOTA: "Louisiana" [near mouth of Niobrara River], 1811, *Bradbury* (PA cotype); Fort Meade, 9 June 1887, *Forwood 144* (M); deundated intervalles of the Missouri hills near White River, May–June 1839, *Geyer* (M); Puncah (Ponca) Village, 16 June 1853–54, *Hayden* (M 124446); cretaceous rocks near mouth of White River, 16 June 1853, *Hayden* (M); Fort Pierre, April 1855, *Hayden* (G); White River, Mauvaises terras, *Hayden* (G); Fort Pierre to Bad Lands, 20 April 1855, *Hayden 4* (G, M); valley of White River, 10 May 1855, *Hayden* (M); Bad Lands, Interior, 9 June 1927, *Hayward 705* (R); high plains, Wakpala, Standing Rock Reservation, 19 June 1909, *Moyer* (MU 164442, NY); Missouri River bottoms, Mobridge, 3 June 1914, *Moyer 398* (MU); bluffs of the Missouri, Walworth Co., 16 June 1909, *Moyer 2673* (MU); Missouri, 1811, *Nuttall* (G, NY); Hermosa, 3500 ft. alt., 23 June 1892, *Rydberg 719* (MU, NY).

NEBRASKA: Whitney, May 1891, *Bates 562* (NY); naked clay soils, Sioux Co., June–July 1927, *Kramer 88* (M).

MONTANA: Upp. Missouri, *Stevens Exp.* (M, NY); Great Falls, 12 May, 1 June 1889, *R. S. Williams 16* (MU).

YELLOWSTONE NATIONAL PARK: on a dry clayey knoll, Glen Creek, 29 June 1899, *Nelson & Nelson 5568* (M, MU, N, NY in part, R); Mammoth Hot Springs, July 1904, *Oleson 325* (R).

WYOMING: in stiff clay soil, Bush Ranch, Sweetwater Co., 10 June 1900, *A. Nelson 7093* (M, MU, NY, R); bad-lands, Powder River, 27 June 1910, *A. Nelson 9398* (M, MU, NY, R).

COLORADO: foothills, w. Ft. Collins, 5500 ft. alt., 7–30 May

1896, *C. F. Baker* (M, N 16910, NY in part); Rocky Mountains, 1857, *Bourgeau* (NY); outside Dixon Cañon, 3 June 1898, *Crandall* (NY); valley, Fossil Creek, 15 June 1906, *Dodds 1990* (R); north Denver, July 1892, *Eastwood 4135* (NY); road to the mouth of Coal Creek Canyon, 8 mi. n. w. of Golden, 7 July 1917, *Johnston & Hedgcock 399* (R); near New Windsor, June 1894, *Osterhout* (MU 164434); west of Loveland, Larimer Co., 18 July 1903, *Osterhout 2801* (NY, R); New Windsor, Weld Co., 18 May, 26 June 1909, *Osterhout 4147* (R); New Windsor, Weld Co., 8 July 1909, *Osterhout 4147* (MU); Boulder Creek, June 1872, *Parry 884* (M); Boulder, 5 June 1914, *Ramaley 9829* (R); plains and foothills near Boulder, Boulder Co., 5000–6000 ft. alt., June 1904, *Tweedy 5599* (NY, R).

The type of *Seseli divaricatum* Pursh, the plant collected by Bradbury, is conspecific with the *Musineon pedunculatum* Nelson. The species *divaricatum* has been most frequently interpreted as the low-growing scabrous form included here under the variety *Hookeri*. This misinterpretation has doubtless been due to the fragmentary type material of the Pursh species and the Nuttall species described by Torrey and Gray and the brevity of the original descriptions. As a consequence the various forms were greatly confused in the early literature, and that confusion has continued more or less to the present day both in herbaria and literature.

1a. **M. divaricatum** var. **Hookeri** (Nutt.) Mathias, new comb.

Seseli lucidum Nutt. Fras. Cat. 1813 [reprinted in Pittonia **2**: 118. 1890], nomen nudum.

"*S. divaricatum* Pursh" acc. to Nutt. Gen. **1**: 194. 1818; Hook. Fl. Bor.-Am. **1**: 264. 1834, as to description; Sims, Bot. Mag. **41**: *t. 1742*. 1835, in part.

Musenium divaricatum var. *Hookeri* (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 642. 1840; Walp. Rep. Bot. Syst. **2**: 427. 1843; Wats. Bibl. Ind. **1**: 426. 1878; Coult. Man. Bot. Rocky Mt. 115. 1885.

M. Hookeri Nutt. acc. to Torr. & Gray, Fl. N. Am. **1**: 642. 1840, in synonymy; Ind. Kew. **2**: 273. 1895.

M. trachyspermum Nutt. in Torr. & Gray, Fl. N. Am. **1**: 642.

1840; Walp. Rep. Bot. Syst. **2**: 427. 1843; Gray, Proc. Acad. Phila. **1863**: 63. 1864; Port. & Coult. Syn. Fl. Col. 51. 1874; Rothr. Rept. U. S. Geogr. Surv. Wheeler **6**: 132. 1878 [Pl. Wheeler.]; Coult. & Rose, Rev. N. Am. Umbell. 111. 1888; Nels. Fl. Wyo. 115. 1896.

M. angustifolium Nutt. in Torr. & Gray, Fl. N. Am. **1**: 642. 1840; Walp. Rep. Bot. Syst. **2**: 427. 1843.

"*M. divaricatum* Nutt." acc. to Gray, Smiths. Contr. **3**[5]: 79. 1852 [Pl. Wright. **1**: 79].

"*Musineon Hookeri* (Nutt.) Torr. & Gray" acc. to Coult. & Rose, Bot. Gaz. **20**: 259. 1895.

Adorium Hookeri (Torr. & Gray) Rydb. Contr. U. S. Nat. Herb. **3**: 501. 1896 [Fl. Black Hills].

"*Musenion Hookeri* Torr. & Gray" acc. to Heller, Cat. N. Am. Pl. 97. 1898.

"*Musineon Hookeri* Nutt." acc. to Rydb. Mem. N. Y. Bot. Gard. **1**: 288. 1900.

"*M. Hookeri* (Torr. & Gray) Nutt. acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 77. 1900; Britt. Man. ed. 2. 1072. 1905; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 349. 1909; Nels. Spring Fl. Intermt. States, 114. 1912; Petersen, Fl. Nebr. 161. 1912.

"*Musenion Hookeri* Nutt." acc. to Heller, Cat. N. Am. Pl. ed. 2. 149. 1900.

"*M. trachyspermum* Nutt." acc. to Heller, Cat. N. Am. Pl. ed. 2. 149. 1900.

"*Musineon trachyspermum* Nutt." acc. to Rydb. Fl. Rocky Mts. 615. 1917, and ed. 2. 615. 1922.

"*M. angustifolium* Nutt." acc. to Rydb. Fl. Rocky Mts. 615. 1917, and ed. 2. 615. 1922.

Stems scaberulent at the base of the umbel to densely scabrous throughout; leaves mostly narrower in outline than in the species, sometimes scabrous along the margins and veins; umbel rays and involucel bracts scabrous; fruit minutely scaberulent to densely scabrous; oil tubes rarely solitary in the intervals.

Type specimen: *Nuttall*, "Plains of the Upper Platte, near the Rocky Mountains," Wyoming (TYPE in the Herbarium of the Academy of Natural Sciences, Philadelphia, cotype in the Herbarium of the New York Botanical Garden).

Distribution: central Saskatchewan to central Colorado, western North Dakota and eastern Wyoming to eastern Nevada.

Specimens examined:

North Dakota: in hard clay soil in valley, Medora, 1 June 1912, *Bergman* (M 916473, MU 164430, NY); Medora flats, 29 May 1904, *Waldron 2316* (R).

South Dakota: frequent on plains, Buffalo Gap to Hot Springs, 1 May 1924, *McIntosh 6* (R).

Nebraska: Whitney, Sioux Co., June 1891, *Bates* (NY).

Texas: 1881, *Havard 5034* (NY) (probably an exchange of labels).

Saskatchewan: Carlton House, *Douglas* (G); *Drummond* (G); Moose Jaw, 16 May 1895, *Macoun 10657* (N, NY); Moose Jaw, 19 May 1895, *Macoun 10659* (N).

Alberta: prairies, McLeod, British Columbia [?], 12 May 1902, *J. R. Anderson* (WSC 48462); clay banks, Belly River, 27 July 1881, *Dawson 9153* (NY); Lethbridge, 5 June 1894, *Macoun 4972* (NY); Jumping Pound Creek, 21 June 1897, *Macoun 20505* (M, NY); dry soil, prairies and hills, Bow Valley west, vicinity of Calgary, 3400–3600 ft. alt., 2 May 1914, *Moodie 274* (NY); dry soil, prairies and hills, Bow Valley, vicinity of Calgary, 3400 ft. alt., 27 April 1915, *Moodie 816* (M, NY).

Montana: mouth of Sand Coulee, 11 April 1885, *F. W. Anderson* (CAL 21286); on the plains, Great Falls, April 1885, June 1886, *F. W. Anderson 3047* (NY); frequent, dry hillsides, Bozeman, 4 July 1898, 7 June 1899, *Blankinship* (M); dry hillsides, Bozeman, 14 July 1898, 16 May 1899, *Blankinship* (NY); Custer, 24 April 1890, *Blankinship 23* (G, M); Custer, 12 May 1890, *Blankinship 28* (MU); dry uplands, Bozeman, 4800 ft. alt., 6 May, 16 June 1905, *Blankinship 217* (M, PA, R); dry ground, Mt. Helena, Helena, 30 June 1883, *Canby 154* (PA); Sheridan, June 1895, *Fitch* (NY); Deer Lodge Valley, 5000 ft. alt., 29 July 1905, *M. E. Jones* (M); Helena, May 1888, *Kelsey* (MU 164439); Helena, May–June 1889, *Kelsey* (MU 164428); in the vicinity of Helena, 29 June 1891, *Kelsey* (NY); plains, Deer Lodge, 15 June 1923, *Kirkwood 1445* (NY); Westby, 17 June 1927, *Larsen 3, 4* (M); Culbertson, 19 June 1927, *Larsen 120* (M); July 1893, *Moore* (M); dry stony roadside, Armstead,

Beaverhead Co., 5500 ft. alt., 6 July 1920, *Payson & Payson 1910* (M, NY, R); Pole Creek, 9000–11,000 ft. alt., 4 July 1897, *Rydberg & Bessey 4615* (NY); mts., Lima, 30 June 1895, *Shear 3359, 3408* (NY); Lima, 29 June 1895, *Shear 3425* (NY); wet places, Melrose, 6 July 1895, *Shear 5021* (NY); Helena, May 1893, *Starz* (M 713570); Deer Lodge, June 1888, *Traphagen* (NY).

YELLOWSTONE NATIONAL PARK: dry hills, near Mammoth Hot Springs, 6200 ft. alt., June 1893, *Burglehaus* (M, MU 164425, 164431); dry grounds near Mammoth Hot Springs, 6000–7000 ft. alt., 24 May 1894, *Burglehaus* (MU 164443); Mammoth Hot Springs, 7 July 1902, *Mearns 1620* (NY); dry slopes, Gardiner River, 6800 ft. alt., June 1885, *Tweedy 853* (F).

WYOMING: rocky ridges, Cooper Lake, Albany Co., 17 June 1901, *Goodding 11* (R); gumbo hillsides, Alcova, Natrona Co., 29 June 1901, *Goodding 149* (M, NY, R); vacant lot, Laramie, Albany Co., 25 May 1928, *Goodman 340* (GO); Converse Co., 14 May 1900, *Hatcher* (C); clay slopes, Orin Jc., Converse Co., *A. Nelson* (R 65372); Laramie, 7 May 1894, *A. Nelson 10* (M, MU, NY, PA); Laramie, 20 May 1894, *A. Nelson 1225* (MU, WSC); Laramie, May 1895, *A. Nelson 1225* (R); Laramie, May 1893, *A. Nelson 1403* (R); Pine Bluffs, 14 May 1897, *A. Nelson 2875* (M, NY, R); Laramie, 7 May 1894, *A. Nelson 3807* (R); Laramie, 7 May 1894, *A. Nelson 3870* (R); sandy or gravelly plains, Sybille, Albany Co., *A. Nelson 7263, 7377* (M, MU, NY, R); sandy plains, Laramie, 25 May 1910, *A. Nelson 9329* (MU, R); Laramie, 24 May 1900, *E. Nelson 186* (NY); Cooper Creek, 11 June 1900, *E. Nelson 232* (NY, R); Freezeout Hills, 11 July 1898, *E. Nelson 4853* (M, NY, R); Platte, Rocky Mts., *Nuttall* (NY TYPE, PA); R. Mts., *Nuttall* (NY, PA); plains at edge of Bates Hole, 20 June 1926, *Payson & Payson 4757* (R); Laramie, 24 May 1897, *R. A. Smith 59* (M); Sheridan Co., 4000 ft. alt., July 1899, *Tweedy 2425* (NY); rolling plains between Sheridan and Buffalo, 3500–5000 ft. alt., 15 June–15 July 1900, *Tweedy 3374* (NY, R, WSC); grassy fields, Hanna Creek (upper), 15 June 1909, *Willits 100* (R).

COLORADO: Boulder, 1896, *Andrews* (P 83208); dry hills, Denver, Denver Co., 1600 m. alt., 25 May 1921, *Clokey 4227*

(M, MU, NY, PA, R); foothills, Larimer Co., 6000 ft. alt., 11 May 1895, *Cowen* (NY); bluffs north of La Porte, 5500 ft. alt., 2 May 1896, *Crandall* (M); hills north of La Porte, 7 May 1898, *Crandall 1438* (MU, PA); bluffs, north of La Porte, 2 May 1896, *Crandall 1439* (R, WSC); American Plains Flora, Lat. 41°, 1862, *Hall & Harbour 214* (M, PA in part); Adam's Ranch, Grover, 1 May 1926, *E. L. Johnston 190* (R); bluffs n. w. of Grover, 24 May 1926, *E. L. Johnston 206* (R); 1907, *E. L. Johnston 458* (R); granite slopes, Pike's Peak region, *Macbride 2679* (M); Mt. Golden, 29 May 1872, *Parry* (M); near Boulder, 1700 m. alt., 30 May 1905, *Ramaley 1015* (R); frequent, on mesas, Boulder, 7 May 1914, *Ramaley 9789* (R); plains near Denver, 1500 m. alt., 8 May 1900, *Rydberg & Vreeland 5839* (NY); 1869, *Thomas* (G).

Idaho: Beaver Cañon, 27 June 1895, *Rydberg* (NY).

Nevada: Cherry Creek, 6000 ft. alt., 19 June 1906, *M. E. Jones* (NY, P 82864); Muncy, 6000 ft. alt., 25 June 1906, *M. E. Jones* (NY, P 82865); Streptoc Valley, 13 July 1891, *M. E. Jones* (P 82862).

This variety grades into the species but by a combination of characters may be separated. Although described by Coulter and Rose as usually having solitary oil tubes in the intervals, that condition is comparatively rare. The more usual condition, probably mistaken by them for a solitary oil tube, is the presence in each interval of one large oil tube accompanied by two comparatively small inconspicuous ones.

2. **M. vaginatum** Rydb. Mem. N. Y. Bot. Gard. **1**: 288. 1900; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 350. 1909; Rydb. Fl. Rocky Mts. 615. 1917, and ed. 2. 615. 1922.

"*Musenion vaginatum* Rydb." acc. to Heller, Cat. N. Am. Pl. ed. 2. 149. 1900.

"*Musenium vaginatum* Rydb." acc. to Ind. Kew. Suppl. **2**: 121. 1904.

Plants caulescent, 0.4–3 dm. high; stems purplish-tinged, glabrous except for a slight scaberulence at the base of the umbel; leaves broadly ovate to oblong-ovate in general outline, excluding the petiole, 1–10.5 cm. long, 1.5–4 cm. broad, twice to thrice ternate, ultimate segments distinct, linear, mucronate, 2–11 mm.

long, about 1 mm. broad, rarely scaberulent on the upper surface, petioles 1–4 cm. long, inflated at the base into a conspicuous, purplish, scarious-margined sheath; peduncles usually exceeding the leaves, umbels several-rayed, rays 0.4–1.7 cm. long, involucre absent or rarely present as a low sheath, involucel bracts linear-lanceolate, shorter than the white or yellowish flowers; fruit ovate-oblong, 3–4 mm. long, 1–2 mm. broad, somewhat glabrous to densely scaberulent, oil tubes mostly three in the intervals, 4–5 on the commissure, strengthening cells absent, seed face plane.

Type specimen: *Rydberg & Bessey 4626*, Bridger Mountains, Montana, 15 June 1897 (TYPE in the Herbarium of the New York Botanical Garden, cotypes in the Edward L. Greene Herbarium of Notre Dame University and the Rocky Mountain Herbarium of the University of Wyoming).

Distribution: known only from the Bridger Mountains, Montana, and the Big Horn Mountains of northern Wyoming.

Specimens examined:

MONTANA: limestone shingle, Mt. Bridger, near Bozeman, 8000 ft. alt., 5 July 1905, *Blankinship 218* (M, PA, R); Bridger Mts., near the Pass, 8000 ft. alt., 28 July 1896, *Flodman 695* (M, NY); Bridger Mountains, 7000 ft. alt., 14 June 1897, *Rydberg & Bessey 4625* (NY); Bridger Mountains, 7000 ft. alt., 15 June 1897, *Rydberg & Bessey 4626* (NY TYPE, N, R).

WYOMING: headwaters of Tongue River, Big Horn Mountains, July 1898, *Tweedy 58* (NY); rolling plains between Sheridan and Buffalo, 3500–5000 ft. alt., 15 June–15 July 1899, *Tweedy 2424* (WSC); rocky hills, Sheridan Co., 4000 ft. alt., July 1899, *Tweedy 2424* (NY).

3. **M. lineare** (Rydb.) Mathias, new comb.

Aletes (?) *tenuifolia* Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 108. 1900.

Daucophyllum lineare Rydb. Bull. Torr. Bot. Club **40**: 69. 1913; Tidestrom, Contr. U. S. Nat. Herb. **25**: 393. 1925 [Fl. Utah & Nev.].

D. linearis Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922.

"*Aletes* (?) *tenuifolius* Coult. & Rose" acc. to Wolff, Pflanzenreich **90**: 141. 1927.

Plants subcaulescent, subcaespitose, 0.8–2.5 dm. high; stems glabrous, slender, lax, usually longer than the leaves; leaves narrowly oblong in general outline, excluding the petiole, 2–5 cm. long, about 2 cm. broad, simply pinnate, ultimate segments (pinnae) distinct, linear, acute, 1–3.5 cm. long, about 1–2 mm. broad; petioles 3–14 cm. long; umbels several-rayed, rays 2–5 mm. long; involucel conspicuous, subdimidiate, bracts distinct, linear-lanceolate, acute, greatly exceeding the yellow flowers; fruit ovate-oblong, 3–4 mm. long, 1–2 mm. broad, minutely scaberulent; oil tubes 2–4 in the intervals, 6–8 on the commissure.

Type specimen: *Rydberg*, near Logan, Utah, 9 Aug. 1895 (TYPE in the Herbarium of the New York Botanical Garden, cotypes in the United States National Herbarium and the Rocky Mountain Herbarium of the University of Wyoming).

Distribution: known only from the vicinity of Logan, Utah.

Specimens examined:

UTAH: Logan, Aug. 1895, *Rydberg* (NY); Logan, 9 Aug. 1895, *Rydberg* (NY TYPE, R 29913, US 391721, 1010452); rocks, Logan, 9 Aug. 1895, *Shear 3162* (NY, US); cliffs, Logan Canyon, Logan, Cache Co., 24 April 1911, *C. P. Smith 2337* (NY, R); Cache, 28 April 1911, *C. P. Smith 2338* (NY).

4. M. tenuifolium (Nutt.) Coult. & Rose.

Pl. 22, fig. 3; pl. 26, fig. 2.

Musenium tenuifolium Nutt. in Torr. & Gray, Fl. N. Am. **1**: 642. 1840; Walp. Rep. Bot. Syst. **2**: 427. 1843; Wats. Bibl. Ind. **1**: 426. 1878; Coult. Man. Bot. Rocky Mt. 115. 1885; Coult. & Rose, Rev. N. Am. Umbell. 111. 1888; Webber, Cat. Fl. Nebr. 124. 1890; Nels. Fl. Wyo. 115. 1896.

Adorium tenuifolium (Nutt.) Kuntze, Rev. Gen. Pl. **1**: 264. 1891; Rydb. Bot. Surv. Nebr. 3: 37. 1894; Britt. Mem. Torr. Bot. Club **5**: 242. 1894; Rydb. Contr. U. S. Nat. Herb. **3**: 501. 1896 [Fl. Black Hills].

"*Musineon tenuifolium* (Nutt.) Torr. & Gray" acc. to Coult. & Rose, Bot. Gaz. **20**: 259. 1895.

"*Musineon tenuifolium* Nutt." acc. to Britt. & Brown, Ill. Fl. **2**: 527. 1897, and ed. 2. **2**: 644. 1913; Britt. Man. 677. 1901, and ed. 2. 677. 1905; Coult. & Nels. Man. Bot. Cent.

Rocky Mts. 350. 1909; Nels. Spring Fl. Intermt. States, 114. 1912; Petersen, Fl. Nebr. 161. 1912.

"*Musenion tenuifolium* Nutt." acc. to Heller, Cat. N. Am. Pl. 97. 1898, and ed. 2. 149. 1900.

"*Musineon tenuifolium* Nutt. in Torr. & Gray" acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 78. 1900.

Daucophyllum tenuifolium (Nutt.) Rydb. Bull. Torr. Bot. Club **40**: 69. 1913; Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922.

Plants acaulescent, erect, subcaespitose, 0.6–3 dm. high; leaves narrowly oblong in general outline, excluding the petiole, 1.5–10 cm. long, 0.5–2.5 cm. broad, simply pinnate to tripinnatisect, ultimate segments distinct, linear, acute, 2–30 mm. long, 0.5–1 mm. broad, petioles 1–12 cm. long; mature peduncles always exceeding the leaves, hirtellous at the base of the umbel; umbel 8–30-rayed, rays of each umbel subequal, 2–20 mm. long, frequently scabrous; involucre mostly absent (when present varying from one inconspicuous, short, linear-lanceolate bract to two prominent, linear-lanceolate bracts equalling the rays in length); involucel of several inconspicuous, linear, acute, green bracts exceeding the white or yellow flowers; fruit ovate to narrowly oblong, slightly constricted at the apex, 2–5 mm. long, 1–2 mm. broad, granular-scabrous, oil tubes mostly 3 in the intervals, 2–4 on the commissure, seed face plane.

Type specimen: *Nuttall*, "Rocky Mountains," probably on the upper Platte River in Wyoming (probable TYPE in the Herbarium of the New York Botanical Garden, cotypes in the Gray Herbarium of Harvard University, and the Herbarium of the Royal Botanic Gardens, Kew).

Distribution: western South Dakota and Nebraska and adjacent Wyoming and Colorado.

Specimens examined:

SOUTH DAKOTA: Elk Mts., 5000 ft. alt., 6 July 1906, *Cary 34* (US); Black Hills, near Ft. Meade, 5 May 1887, *Forwood 146* (US); Fort Meade, 11 June 1887, *Forwood 146* (M); sand hills and on Running Water, 12 Aug. 1853–4, *Hayden* (M); Running Water, 14 Aug. 1853–4, *Hayden* (M); hills surrounding lake, Sylvan Lake, Black Hills, 9 Aug. 1926, *Hayward 318* (NY); exposed

hillsides, Deadwood, 19 June 1927, *Hayward 1161* (R); red foothills, Buffalo Gap, 27 June 1927, *Hayward 1542* (R); Black Hawk, on shale hillsides, 10 May 1924, *Lee* (US 1244505); Spring Creek, Rockerville Road, 20 April 1925, *Lee* (R 106147); rocky ridges, Tilford, Elk Creek, Piedmont, 16 May 1924, *McIntosh 65* (R); head of City Creek, Deadwood, 5300 ft. alt., 10 July 1909, *Murdoch 3538* (US); rim of Spearfish Canyon near Savoy, 5500 ft. alt., 21 June 1910, *Murdoch 4128* (F, NY); rock crevices, Rapid Canyon, Pennington Co., 27 June 1914, *Over 1642* (US); hillsides, Mayo, Custer Co., 15 June 1914, *Over 1792* (US); high limestone ridges, Box Elder Creek, Black Hills, June 1887, *W. S. Rusby* (NY); Custer, 5500 ft. alt., 4 June 1892, *Rydberg 718* (US); Sylvan Lake, 7000 ft. alt., 8 June 1892, *Rydberg 718* (US); Hot Springs, 3500 ft. alt., 13 June 1892, *Rydberg 718* (NY, US); Custer, 5500 ft. alt., 1 Aug. 1892, *Rydberg 718* (NY); hills west of Rapid City, 1 Aug. 1908, *Visher* (F 244470); hillside, Indian Creek, Fall River Co., 1 Aug. 1911, *Visher 2671* (F); on dry knolls in the Black Hills, Rockerville, June 1909, *White* (M); Hot Springs, 27 Aug. 1898, *C. S. Williamson* (PA).

Nebraska: Cheyenne Co., Aug. 1901, *H. P. Baker* (M); Pine Ridge, Dawes Co., 4600 ft. alt., 29 June 1889, *C. E. Bessey* (US); Dawes Co., July 1889, *Bessey & Webber* (CH 361700); on rocky habitats, Sioux Co., June–July 1927, *Kramer 19* (M); hills, Banner Co., Aug. 1890, *Rydberg 74* (NY); Court House Rock, Cheyenne Co., 4 July 1891, *Rydberg 127* (US); hills south of Pumpkin Seed Valley, Scott's Bluff Co., 6 July 1891, *Rydberg 127* (US); hills in Pleasant Valley, Scott's Bluff Co., 28 July 1891, *Rydberg 127* (F, NY); high rocky ridges, Belmont, Dawes Co., July 1889, *Webber* (NY); Pine Ridge, 20 July 1889, *Webber* (M); high rocky prairies, Hot Creek Basin, Sioux Co., 2 Aug. 1889, *Webber* (US); War Bonnet Cañon, 5000 ft. alt., 23 June 1890, *T. A. Williams* (US 750360); War Bonnet Cañon, 23 June 1891, *T. A. Williams* (M); War Bonnet Cañon, 5200 ft. alt., 23 June 1890, *T. A. Williams 308* (US).

Wyoming: Douglas, 1 June 1891, *Bates* (B); top of a flat desert hill, T. B. Ranch, Carbon Co., 20 June 1901, *Goodding 47* (F, M, NY, R, US); barren ground, top of Como Bluff, Albany

Co., 26 May 1929, *Goodman 349* (GO); Sheep Creek, 1 June 1900, *Hatcher* (C); Laramie Mountains, 1923, *Kemp 16* (NY); Lusk, 28 June 1896, *Knowlton 108* (NY, US); along hillsides, Beaver Creek, Harper Ranch, near Newcastle, 24 Aug. 1929, *Mathias 790* (M); Chimney Rock, 8 Aug. 1896, *A. Nelson* (R 7221); Laramie Hills, May-June 18—, *A. Nelson 72* (CH, US); Laramie Hills, 7 June 1894, *A. Nelson 176* (B, M, MU, NY, PA, US, WSC); Horse Creek, June 1893, *A. Nelson 1404* (R); in rich soil in ravines, Pine Bluffs, Laramie Co., 14 May 1897, *A. Nelson 2878* (US); stony slopes, Laramie Hills, Albany Co., 10 June 1897, *A. Nelson 2378* (C, M, MU, NY, R, US 43302 in part); in dry gravelly soil, Laramie Hills, Albany Co., 16 June 1897, *A. Nelson 3168* (US); Laramie Hills, Albany Co., Aug. 1897, *A. Nelson 3168a* (US); rocky ledges and ravines, Laramie Hills, 7 June 1894, *A. Nelson 3941* (*176*) (R); Laramie Hills, 25 June 1898, *A. Nelson 4356* (F, R 12351, 12737 in part); Platte Hills, 11 July 1894, *A. Nelson 4819* (*391*) (R); stony ridges, Laramie Hills, Albany Co., July 1903, *A. Nelson 8977* (C, M, MU, NY, R); stony ridges, Orin Jc., May 1907, *A. Nelson 9132* (R); Laramie Hills, Laramie, 4 June 1900, *E. Nelson 216* (NY); Rocky Mts., *Nuttall* (NY TYPE, G, K, M photograph); Rocky Mts., *Nuttall* (NY, PA); bad lands, Niobrara Co., 6 Sept. 1924, *Over 16375* (R); rock crevices, Freezeout Hills, north of Medicine Bow, 21 June 1926, *Payson & Payson 4808* (R); dry hills, Pine Bluffs, Laramie Co., 28 July 1889, *Rodin* (MU 164447); in a ditch east of Laramie, 7 June 1902, *Sellon 29* (R); on the hills east of Laramie, 31 May 1902, *Sellon 64* (R); Rocky Mountains, 1869, *Thomas* (US 215914).

COLORADO: Pawnee Buttes, Weld Co., 17 June 1919, *Osterhout 5903* (R).

EXCLUDED SPECIES

Musineon alpinum Coult. & Rose, Bot. Gaz. **20**: 260. 1895 = **Tauschia alpina** (Coult. & Rose) Mathias, new comb.

"*Musenium alpinum* Coult. & Rose" acc. to Ind. Kew. Suppl. **1**: 284. 1906 = **Tauschia alpina** (Coult. & Rose) Mathias.

Musineum Ehrenbergii Wolff, in Fedde, Repert. Nov. Sp. **8**: 524. 1910 = **Tauschia Ehrenbergii** (Wolff) Mathias, new comb.

Musineon alpinum Coult. & Rose and *Musineum Ehrenbergii*

Wolff are not congeners of the *Musineon* of Rafinesque. Their exact position is somewhat doubtful but the material at hand, including the type specimen of *M. alpinum* and a fragrant of the type of *M. Ehrenbergii*, would warrant their transfer to the genus *Tauschia* as defined in the broader sense by Macbride.[49] The genera included in the *Tauschia* complex have been so poorly defined and delimited that it seems best to treat them as members of a polymorphic genus until a detailed monographic study of the group can be made and more material obtained of some of the questionable species.

Musenium Greenei Gray, Proc. Am. Acad. 8: 387. 1872 = **Aletes acaulis** (Torr.) Coult. & Rose, Rev. N. Am. Umbell. 126. 1888.

III

HARBOURIA Coult. & Rose

Harbouria Coult. & Rose, Rev. N. Am. Umbell. 26, 125. 1888; Engler & Prantl, Nat. Pflanzenf. 3[8]: 187. 1898; Coult. & Rose, Contr. U. S. Nat. Herb. 7: 92. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 350. 1909; Daniels, Fl. Boulder, Col. 182. 1911; Clem. & Clem. Rocky Mt. Fl. 229. 1914; Rydb. Fl. Rocky Mts. 617. 1917, and ed. 2. 617. 1922; Wolff, Pflanzenreich 90: 71. 1927.

Erect, branching, subcaespitose perennials with long slender tap-roots. Stems grooved, glabrous or pubescent. Leaves petiolate, thin, tri–quadri-pinnatisect; ultimate leaf divisions linear, distinct, acute, mucronulate; petioles slightly sheathing at the base. Inflorescence spreading, more or less scaberulent; peduncles terminal (usually in pairs), much exceeding the leaves; involucre usually absent; involucel bracts few, inconspicuous, lanceolate; calyx teeth inconspicuous; flowers yellow; stylopodium lacking. Carpophore entire. Fruit ovate, granular-roughened, flattened laterally, conspicuously constricted at the commissure, carpels appearing nearly distinct, subterete in cross-section with 4–6 distinct, subequal, corky ribs; oil tubes large, mostly solitary in the intervals, 1–3 on the commissural side; strengthening cells present or absent.

Type species: **Harbouria trachypleura** (Gray) Coult. & Rose, Rev. N. Am. Umbell. 125. 1888.

[49] Macbride, Contr. Gray Herb. N. S. 56: 28. 1918.

1. H. trachypleura (Gray) Coult. & Rose, Rev. N. Am. Umbell. 125. 1888; Nels. Fl. Wyo. 115. 1896; Heller, Cat. N. Am. Pl. 97. 1898, and ed. 2. 149. 1900; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 93. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 350. 1909; Daniels, Fl. Boulder, Col. 182. 1911; Rydb. Fl. Rocky Mts. 617. 1917, and ed. 2. 617. 1922; Wolff, Pflanzenreich **90**: 71. 1927.

Pl. 27, fig. 2.

Thaspium trachypleurum Gray, Proc. Acad. Phila. **1863**: 63. 1864; Port. & Coult. Syn. Fl. Col. 52. 1874.

Cicuta (?) *trachypleura* (Gray) Wats. Bibl. Ind. **1**: 417. 1878; Coult. Man. Bot. Rocky Mt. 116. 1885.

"*Thaspium montanum*, var. *tenuiflorum*. Gray, Am. Jour. Sci. 2. 33. 408." acc. to Wats. Bibl. Ind. **1**: 417. 1878, err. typ.

Thaspium montanum var. *tenuifolium* Gray, Am. Jour. Sci. II, **33**: 408. 1862, as to *Parry no. 159*, not *T. montanum* var. *tenuifolium* Gray, Smiths. Contr. **5**: 65. 1853 [Pl. Wright. **2**: 65. 1853], namely *Wright no. 1107*.

Plants caulescent, 0.8–5.5 dm. high; stems glabrous except for hirtellous pubescence at the base of the umbel; leaves mostly basal, ovate-oblong in general outline, excluding the petiole, 2.5–20 cm. long, 2–12 cm. broad, tri–quadri-pinnatisect, ultimate segments 2–30 mm. long, 0.5–1 mm. broad, petioles 0.8–20 cm. long, cauline leaves similar to the basal leaves; umbels 8–30-rayed, rays of each umbel subequal, 5–35 mm. long; involucre occasionally present in the form of one or two inconspicuous lanceolate bracts; involucel bracts linear, acute, usually shorter than the pedicels; fruit 3–6 mm. long, 3–4 mm. broad, ribs mostly obtuse in cross-section, oil tubes mostly solitary in the intervals, 1–3 on the commissural side.

Type specimen: *Hall & Harbour 215* "On the mountains, at middle and lower elevations," Colorado, 1862 (TYPE in the Gray Herbarium of Harvard University, cotypes in the herbaria of the Missouri Botanical Garden, the United States National Museum, the Academy of Natural Sciences, Philadelphia, the Field Museum of Natural History, and the Brooklyn Botanic Garden).

Distribution: southern Wyoming to central New Mexico.

Specimens examined:

Wyoming: Laramie Mts., east of Laramie, 18 June 1909, *Cary 301* (US); aspen groves, Sheep Mountain, Albany Co., 2 Sept. 1903, *Goodding 2100* (C, M, NY, R, US); along brook, near Chimney Rock, Laramie Plateau, 29 July 1929, *Greenman & Greenman 6062* (M); Laramie Hills, May–June 1893, *A. Nelson 4* (F, US); Pole Creek, hills near Table Mt., 2 June 1894, *A. Nelson 160* (MU, PA); Table Mt., 2 June 1894, *A. Nelson 160* (C, G, M, MU, NY, US); Laramie Hills, June 1893, *A. Nelson 1399* (R); Laramie Hills, 13 June 1896, *A. Nelson 1948* (MU); Wood's Creek, 11 Aug. 1896, *A. Nelson 2099* (R); hillsides, Medicine Bow Mts., Albany Co., 10 Aug. 1897, *A. Nelson 3365* (R, US); Pole Creek, near Table Mt., 2 June 1894, *A. Nelson 3956* (*160*) (R); Laramie Hills, 25 June 1898, *A. Nelson 4356* (C, R 12737 in part); dry stony hillsides, Sand Creek, Albany Co., 1 June 1900, *A. Nelson 7011* (C, G, M, MU, NY, R, US); dry, stony bottoms, Centennial, Albany Co., 27 July 1902, *A. Nelson 8687* (F, G, M, NY, R, US); head of Pole Creek, 3 July 1901, *E. Nelson 603* (G, NY); La Barge, Uinta Co., 17 July 1894, *E. Stevenson 31* (US); Little Laramie River, Sheep Mts., 23 July 1897, *P. A. Williams* (NY).

Colorado: foothills, w. Ft. Collins, 5500 ft. alt., 24 May 1896, *C. F. Baker* (F, M, N 16866, NY); foothills, 6 mi. w. Ft. Collins, 5500 ft. alt., 24 May 1896, *C. F. Baker 1* (US); hills, Larimer Co., 5500 ft. alt., 12 May 1895, *C. F. Baker* (*Patterson 3988*) (M); Log Cañon and Rist Cañon, 74 mi. north of Denver on U. P. RR., 6000–7000 ft. alt., 31 May 1896, *Baker & Holzinger 4* (US); near Golden, 1887, *Berthoud* (CH 361696); Morrison, Oct. 1897, *Bethel* (US 329880); Morrison, June 1895, *Bethel 36–12* (US); Gore Mts., 9500 ft. alt., Aug. 1895, *Bethel 36–13* (US); dry soil, Morrison, Jefferson Co., 1960 m. alt., 3 June 1921, *Bethel & Clokey 4222* (F, M, MU, PA, R, US); Grand Cañon of the Arkansas, 1873, *T. S. Brandegee* (M, PA); mts., Aug. 1871, *Canby* (G); dry hills, Boulder, Boulder Co., 1635 m. alt., 19 June 1921, *Clokey 4224* (R); Long's Peak Inn, Estes Park, 9000 ft. alt., 18 May 1908, *Cooper 14* (R); Estes Park, 7500 ft. alt., 13 July 1904, *Cooper 45* (R); Long's Peak Inn, Estes Park, 9000 ft. alt., 10 June 1908, *Cooper 59* (R); Estes Park, 9000 ft. alt., 17 Aug.

1906, *Cooper 156* (R); Estes Park, 7500 ft. alt., 13 July 1904, *Cooper 261* (R); St. Vrain Cañon, 26 May 1873, *Coulter* (PA, US); foothills, Larimer Co., 6000 ft. alt., 21 May 1892, 25 June 1895, *Cowen* (NY); Bosworth's Ranch, Stove Prairie, 20 Aug. 1895, *Cowen* (NY); foothills, Larimer Co., 6000 ft. alt., 9 May 1896, *Cowen 27* (NY); Howe's Gulch, 1 May 1890, *Cowen 1402* (US); Bosworth's Ranch, Stove Prairie, 7500 ft. alt., 20 Aug. 1895, *Cowen 1405* (NY); foothills, Ft. Collins, 6000 ft. alt., 9 May 1896, *Cowen 1407* (G, MU, NY, R); Rist Cañon, 30 May 1891, *Crandall* (US 216531); foothills, 5500 ft. alt., 13 June 1896, *Crandall* (M); Pennock's, 13 June 1896, *Crandall* (NY); mountains, Larimer Co., 7500 ft. alt., 13 June 1896, *Crandall* (R 8401); foothills, 5500 ft. alt., 12 May 1893, *Crandall 4* (US); hillsides, foothills, 6500 ft. alt., 27 May 1893, *Crandall 188* (US); Gregory Cañon, 6400 ft. alt., 16 July 1906, *Daniels 157* (M); St. Vrain Creek, 9 June 1906, *Dodds 1890* (R); Central City, Oct. 1892, *Eastwood* (F, US); Genesee Mt., 27 May 1916, *Eastwood 5437* (US); rocky mountain tops, near Spring Creek, 8500–9000 ft. alt., 31 July 1874, *G. Engelmann* (M); rocky slopes at Idaho and Fall River, 26 Aug. 1874, *G. Engelmann* (M); lower mts., *Greene 580* (G); Rocky Mountain Flora, Lat. 39°–41°, 1862, *Hall & Harbour 215* (G TYPE, B, F, M, PA, US); common, dry slopes, Ward, 9500 ft. alt., 25 June 1921, *H. C. Hanson C 260* (M); infrequent among pines, upper mesas, near Boulder, about 5800 ft. alt., 27 May 1921, *H. C. Hanson C 263* (M); Estes Park, 22 June 1913, *E. L. Johnston 751* (M, NY); Estes Park, 22 June 1913, *E. L. Johnston 895* (US); foothills near Golden, 6500 ft. alt., 20 June 1878, *M. E. Jones 278* (C, NY); Penn Gulch, Boulder Co., 7700 ft. alt., July 1885, *Letterman* (F 348463); Penn's Gulch, 20 July 1885, *Letterman* (G); Penn's Gulch, near Sunset, 30 July 1886, *Letterman* (M 776554, NY, PA); Howe's Gulch, 13 June 1899, *Marshall* (NY); Howe's Gulch, 13 June 1899, *Marshall 1408* (F, R, US); Masonville Road, west of Ft. Collins, 20 June 1929, *Mathias 362* (M); Fern Lake Trail, Estes Park, 20 June 1929, *Mathias 436* (M); Aspenglen Camp, Fall River Road, near Estes Park, 22 June 1929, *Mathias 445* (M); marshy field, Middle St. Vrain Cañon, near Estes Park, 24 June 1929, *Mathias 478* (M); Golden City, Aug. 1871, *Meehan* (PA); Estes Park,

20–30 Aug. 1898, *Moyer* (MU 163846); mts., 1894, *Osterhout* (PA); near Estes Park, June 1894, *Osterhout* (MU 163845); foothills, Larimer Co., July 1895, *Osterhout* (G, PA, US 231800); from the head-waters of Clear Creek, and the alpine ridges lying east of "Middle Park," 1861, *Parry 159* (G); Bear Creek Cañon, 24 June 1929, *Phelps* (CAS 164795); Rocky Mts., near Idaho Springs, 2 Aug. 1872, *Porter* (PA); near Boulder, 20 June 1900, *Ramaley A. 84* (R); Nederland, 2500 m. alt., 1 July 1905, *Ramaley 1136* (R); Smartweed Lake, near Rollinsville, 9 Aug. 1911, *Ramaley 9020* (R); Boulder, 28 July 1913, *Ramaley 9706* (R); near Ward, Boulder Co., about 9500 ft. alt., 18 July 1907, *Ramaley, Dodds & Robbins 3190* (R); Arkansas Cañon, 22 July 1872, *Redfield 470* (M, PA); Boulder, 2 Sept. 1895, *Rydberg* (NY); Clear Creek Cañon, 5 June 1893, *Schneck* (M); dry hills in Platte Cañon, 4 July 1885, *B. H. Smith* (PA); Rocky Mountains, 1869, *Thomas* (G, US); Golden, 22 Sept. 1887, *S. M. Tracy* (CH 375310); mountains between Sunshine and Ward, Boulder Co., 8000–9500 ft. alt., Aug. 1902, *Tweedy 4990* (NY, R); plains and foothills near Boulder, Boulder Co., 6000 ft. alt., July 1902, *Tweedy 4991* (NY, R); mountains between Sunshine and Ward, Boulder Co., 8000–9500 ft. alt., Aug. 1902, *Tweedy 4992* (NY, R); Empire, Clear Creek Co., 8500 ft. alt., 15–25 July 1903, *Tweedy 5600* (NY, R); Rocky Mountains, Lat. 40°–41°, 1868, *Vasey 225* (G); Boulder, Boulder Co., 25 May 1912, *Vestal 370* (M).

New Mexico: vicinity of Las Vegas, San Miguel Co., June 1920, *Anect 157* (NY); vicinity of Las Vegas, San Miguel Co., Oct. 1919, *Anect 279* (US); Las Vegas, Romersville, 2000 m. alt., 23 July 1926, *Arsène & Benedict 15456* (US); Oscuro Mts., 21 July 1898, *F. S. Earle 112* (M, NY); elevated rocky region E. of Mora River, 17 Aug. 1847, *Fendler 277* (G, M); Las Vegas, June 1903, *G. B. Grant 544* (F); brushy hillside, vicinity of Ute Park, Colfax Co., 2200–2900 m. alt., 20 Aug. 1916, *Standley 13390* (US); oak thicket, vicinity of Ute Park, Colfax Co., 2200–2900 m. alt., 24 Aug. 1916, *Standley 13687* (US).

Utah: Gilbert's Meadow, Uinta Mts., 10,000 ft. alt., 28 July 1873, *Porter* (PA).

IV

RHYSOPTERUS Coult. & Rose

Rhysopterus Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 185. 1900, in part; Tidestrom. Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.], as to name only.

Low, herbaceous, subprostrate, acaulescent (appearing caulescent with the development of a pseudoscape), glabrous perennials with long, simple tap-roots. Leaves petiolate, subcoriaceous, ternate, then subpinnate; leaf segments 1.5–3 cm. long, 2.5–4 cm. broad; petioles slightly sheathing, mostly scarious-winged throughout their length. Inflorescence spreading, peduncles shorter than to slightly exceeding the leaves; involucre absent; involucel conspicuous, dimidiate, foliaceous; calyx teeth conspicuous; flowers white; stylopodium lacking. Carpophore obsolete in the mature fruit. Fruit ovate, boat-shaped, flattened laterally with 7 conspicuous, equal, obtuse, corky ribs; oil tubes solitary in the intervals, 2 on the commissure, solitary in the apex of each rib; seed face concave.

Type species: **Rhysopterus plurijugus** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 186. 1900.

1. R. plurijugus Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 186. 1900. Pl. 22, fig. 5; pl. 27, fig. 1.

Cymopterus plurijugus (Coult. & Rose) Jones, Contr. West. Bot. 12: 25. 1908.

Plants, including the pseudoscape, 10–15 cm. high; pseudoscape 4–13 cm. long; leaves ovate-oblong in general outline, excluding the petiole, 1–4 cm. long, 1.5–5 cm. broad, ternate or biternate, then pinnatisect with the segments confluent, giving the appearance of a lobed leaflet, ultimate segments (lobes) 1–4 mm. long, about as broad, mucronulate, petiole 0.5–3 cm. long; umbels several-rayed, rays stout, 5–14 mm. long, subequal in each umbel, reflexed in the fruiting stage, involucel bracts ovate-oblong, acute, mucronulate, frequently scarious-margined, exceeding the pedicels; fruit ovate to orbicular, 3–4 mm. long, 2–3 mm. broad, sometimes purplish-tinged, lateral and dorsal ribs similar, in the young fruit appearing wing-like; oil tubes solitary in the intervals, 2 on the commissure, solitary in the apex of each rib.

Type specimen: *Leiberg 2240*, "black serpentine dykes around a peak rising from Malheur Valley about 12 km. west of confluence of Cottonwood Creek and Malheur," near Harper Ranch, Malheur Valley, Oregon, 1000 m. alt., 10 June 1896 (TYPE in the United States National Herbarium, cotypes in the herbaria of the California Academy of Science, the Field Museum of Natural History, State College of Washington, and the University of California and the Gray Herbarium of Harvard University).

Distribution: Malheur Valley and adjacent regions, Oregon.

Specimens examined:

OREGON: Indian Creek, Malheur Co., June 1896, *Leiberg* (US 258913); loose soil on black volcanic dykes, Malheur Valley, near Harper Ranch, 1000 m. alt., 10 June 1896, *Leiberg 2240* (US TYPE, CAL, CAS, F, G, WSC); dry sandy ground, Narrows, Harney Co., 4 July 1912, *Peck 6448* (F).

EXCLUDED SPECIES

R. corrugatus (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 187. 1900 = **Cymopterus corrugatus** Jones, Am. Nat. **17**: 973. 1883.

R. Jonesii Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 186. 1900 = **Cymopterus Coulteri** (Jones) Mathias, new comb.

V

NEOPARRYA Mathias

Neoparrya Mathias, Ann. Mo. Bot. Gard. **16**: 393, *pl. 33*. 1929. Pl. 22, fig. 2.

The type species is **Neoparrya lithophila** Mathias, Ann. Mo. Bot. Gard. **16**: 393, *pl. 33*. 1929.

The genus is known only from the type locality in northern New Mexico. It differs from *Cymopterus* in its spreading inflorescence with reflexed rays and in the development of small ribs and scattered oil tubes.

VI

ALETES Coult. & Rose

Aletes Coult. & Rose, Rev. N. Am. Umbell. 27, 125. 1888; Engler & Prantl, Nat. Pflanzenf. **3**[8]: 193. 1898; Coult. & Rose,

Contr. U. S. Nat. Herb. **7**: 106. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 351. 1909; Daniels, Fl. Boulder, Col. 182. 1911; Nels. Spring Fl. Intermt. States, 115. 1912; Clem. & Clem. Rocky Mt. Fl. 226. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 479. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922; Wolff, Pflanzenreich **90**: 140. 1927.

Herbaceous, caespitose, acaulescent, glabrous or pubescent perennials, with long, more or less slender roots. Leaves petiolate, thin, simply to tri-pinnatisect; ultimate leaf divisions 0.5–10 mm. long, 0.5–5 mm. wide; petioles slightly sheathing at the base. Inflorescence spreading, peduncles shorter than or exceeding the leaves; involucre mostly absent; involucel bracts inconspicuous, linear to triangular; calyx teeth conspicuous; flowers yellow; stylopodium lacking. Carpophore persistent, 2-parted. Fruit ovate-oblong to oblong, subterete in cross-section, sometimes flattened laterally; ribs present or obsolete, corky; oil tubes large, solitary in the intervals, 2 on the commissural side, sometimes solitary in the apex of the ribs in cross-section, strengthening cells inconspicuous; seed face plane or concave.

Type species: **Aletes acaulis** (Torr.) Coult. & Rose, Rev. N. Am. Umbell. 126. 1888.

KEY TO SPECIES

A. Peduncles exceeding the leaves, 9–27 cm. long; rays of the umbel 5–30 mm. long; ribs of the fruit well-developed............... *1. A. acaulis*

AA. Peduncles shorter than the leaves, 1–4 cm. long; rays of the umbel 20–45 mm. long; ribs of the fruit obsolete..................... *2. A. humilis*

1. A. acaulis (Torr.) Coult. & Rose, Rev. N. Am. Umbell. 126. 1888; Heller, Cat. N. Am. Pl. 95. 1898, and ed. 2. 150. 1900; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 106. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 352. 1909; Daniels, Fl. Boulder, Col. 183. 1911; Nels. Spring Fl. Intermt. States, 115. 1912; Clem. & Clem. Rocky Mt. Fl. 226. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 479. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922; Wolff, Pflanzenreich **90**: 141. 1927.

Pl. 22, fig. 4; pl. 28, fig. 1.

Deweya (?) acaulis Torr. Pacif. R. R. Rept. **4**: 94. 1856; Bot. Whipple's Exp. 38 [94]. 1857.

Oreosciadium acaule (Torr.) Gray, Proc. Am. Acad. **7**: 343. 1867; Wats. Bibl. Ind. **1**: 427. 1878.

Seseli Hallii Gray, Proc. Am. Acad. **8**: 288. 1870; Port. & Coult. Syn. Fl. Col. 52. 1874.

Musenium Greenei Gray, Proc. Am. Acad. **8**: 387. 1872.

Carum (?) Hallii (Gray) Wats. Bibl. Ind. **1**: 416. 1878; Coult. Man. Bot. Rocky Mt. 115. 1885.

Zizia Hallii (Gray) Coult. & Rose, Bot. Gaz. **12**: 137. 1887, in foot note.

Aletes obovata Rydb. Bull. Torr. Bot. Club **31**: 573. 1904; Fl. Col. 252. 1906; Coult. &. Nels. Man. Bot. Cent. Rocky Mts. 352. 1909; Daniels, Fl. Boulder, Col. 182. 1911; Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922.

Plants 0.5–3.5 dm. high; leaves oblong in general outline, excluding the peticle, 2–10 cm. long, 1–4 cm. broad, bi-tri-pinnatisect, ultimate segments linear to ovate, acute, confluent, usually appearing as teeth of obovate to cuneate leaflets of a simply pinnate leaf, sometimes puberulent on the veins and ciliate, 0.5–10 mm. long, 0.5–3 mm. broad, petiole 1.5–15 cm. long; peduncles exceeding the leaves, 9–27 cm. long, occasionally puberulent at the base of the umbel, rays of the umbel 5–30 mm. long, stiff, spreading to reflexed, sometimes puberulent, involucre mostly absent, involucel bracts about equalling the flowers, membranous, narrowly triangular, subacuminate, sometimes ciliate; fruit oblong, 4–7 mm. long, about 2 mm. broad, lateral ribs short and obtuse in cross-section, corky, dorsal ribs 2–3, similar to the laterals, oil tubes solitary in the intervals, 2 on the commissure, accessory oil tubes solitary in the apex of each rib.

Type specimen: *Bigelow*, "in crevices of rocks near Santa Antonita, New Mexico," Oct. 1853 (TYPE in the New York Botanical Garden Herbarium, cotype in the Gray Herbarium of Harvard University).

Distribution: mountains of Colorado, south through New Mexico to western Texas.

Specimens examined:

TEXAS: rocks, Chisos Mts., Aug. 1883, *Havard* (US 156546);

in clefts and crevices of porphyritic cliffs, near Mt. Livermore, Davis Mountains, Jeff Davis Co., 2200 m. alt., 11 June 1926, *E. J. Palmer 30773* (M, PA); Star Canyon, 11 April 1917, *Young 68* (US).

COLORADO: Morrison, Oct. 1897, *Bethel* (US 329878); mts., Morrison, 6000 ft. alt., May 1895, *Bethel 36-11* (US); dry soil, Mt. Morrison, Jefferson Co., 1960 m. alt., 3 June 1921, *Bethel & Clokey 4228* (F, M, NY, PA, R, US); dry hills, mts., Aug. 1871, *Canby* (G); *Carleton* (CH 353079); Golden, 7000 ft. alt., 30 April 1892, *Crandall* (NY, US 216825); gulch south of Boulder, 6000 ft. alt., 23 May 1896, *Crandall* (M, NY, R); Clear Creek Cañon, above Golden, 6500 ft. alt., 30 April 1892, *Crandall 254* (G); gulch south of Boulder, 23 May 1896, *Crandall 1374* (NY, R); foot-hills, Boulder, 6000 ft. alt., 25 June 1906, *Daniels 145* (M); near Morrison, 1891, *Eastwood* (US 44697); 1872, *Greene* (G, NY); near Morrison, 27 July 1889, *Greene* (N 21130, NY); shade, lower mts., Golden City, &c., 1871, *Greene 582* (G); *E. Hall* (CH 366096, US 44711, 770397); low mountains, Rocky Mountain Flora, Lat. 39°–41°, 1862, *Hall & Harbour 221* (G, M); hillsides, Sunshine, 7500 ft. alt., 16 July 1920, *H. C. Hanson C257* (M); in the aspen zone near Golden City, Clear Creek Cañon, 5655 ft. alt., 20 July 1899, *Holm* (F 214725); Clear Creek Cañon, near Golden City, 5650 ft. alt., 20 July 1899, *Holm 95* (M); Boulder Co., Aug. 1892, *M. Holzinger* (US 44710); Golden, Lookout Mountain, 4 June 1916, *E. L. Johnston 872b* (NY, US); Ute Pass, Colorado Springs, 18 May 1878, *M. E. Jones 84*, in part (NY); South Table Mt., Golden, 17 June 1896, *Knowlton 76* (NY, US); Penn's Gulch, near Sunset, 30 July 1886, *Letterman 35* (M); 188-, *Mohr 27*, in part (US); Lower Boulder Cañon, Boulder Co., 25 June 1901, *Osterhout 2433* (NY, PA, R); Canyon of Thompson River, Larimer Co., 15 Aug. 1905, *Osterhout 3097* (R); Boulder, 1908, *Pace 271* (M); Gold Hill, 1875, *Patterson* (G); Castle Rock, 6000 ft. alt., 1 July–9 Sept. 1885, *Patterson 37* (CH, G, M, US); Gold Hill, Boulder Co., Aug. 1882, *Patterson & Beaty* (G, M, NY, US 1384121); Gregory Cañon, near Boulder, 8 June 1901, *Ramaley 719* (R); Mont Alto, near Boulder, 2300 m. alt., 16 Aug. 1901, *Ramaley 832* (R); Boulder Falls, 2200 m. alt., 2 July 1905, *Ramaley 1217* (R); Sugar Loaf Mt., 14 July 1906,

Ramaley & Robbins 1781 (R); ridge, Colorado Springs, 21 July 1909, *Robbins 6447* (R); Glacier Lake, 23 Aug. 1912, *H. H. Rusby* (NY); Boulder, 2 Sept. 1895, *Rydberg* (NY); rocks, Boulder, Sept., 3 Oct. 1895, *Shear 4738* (NY, US); Golden, 1887, *S. M. Tracy* (CH 375311); mountains between Sunshine and Ward, Boulder Co., 8000–9500 ft. alt., Aug. 1902, *Tweedy 4986, 4987* (NY, R); Rocky Mountains, Lat. 40°–41°, 1868, *Vasey 220* (M); Bear Creek, 12 miles west of Denver, 1868, *Vasey 221* (G).

NEW MEXICO: crevices of rocks, San Antonita, 9 Oct. 1853, *Bigelow* (NY TYPE, G); crevices of rocks, ridge between Las Huertas Canyon and Lagunita, Sandia Mts., 10 March, *Ellis 396* (US); Socorro, 10 Aug. 1895, *Plank* (NY); Socorro, May 1881, *Vasey* (CH 375807, G, US 44676, 156545); Sandia Mountains, Sandoval Co., 4 Aug. 1910, *Wooton* (US 737550).

This species has been referred to six genera, as may be seen from the synonymy, and stood under three of them at the same time. Torrey[50] in 1856 doubtfully referred a plant collected by Dr. J. M. Bigelow "In crevices of rocks near Santa Antonita, New Mexico," in October 1853, to the genus *Deweya*, describing it as a new species. This plant, now in the New York Botanical Garden Herbarium, must be taken as the historical type of the genus. Gray[51] in 1867 transferred the species to *Oreosciadium*. In 1870 a plant appeared in the Hall and Harbour collection and was described by Dr. Gray[52] as *Seseli Hallii*. In 1872 Gray[53] described a plant, sent to him by Rev. E. L. Greene, as *Musenium Greenei*. These three plants have since proved to be conspecific. Thus the same species was known under three generic names at the same time, *Oreosciadium*, *Seseli*, and *Musenium*. Watson[54] in his 'Bibliographical Index' recognized the fact that *Seseli Hallii* and *Musenium Greenei* were conspecific and referred both doubtfully to *Carum Hallii*. He maintained *Oreosciadium acaule* as a distinct species. In 1887 Watson[55] recognized the identity of *Oreosciadium acaule* with his *Carum Hallii*, and for the first time

[50] Torrey, Pacif. R. R. Rept. **4**: 94. 1856.
[51] Gray, Proc. Am. Acad. **7**: 343. 1867.
[52] Gray, Proc. Am. Acad. **8**: 288. 1870.
[53] *Ibid.* 387. 1872.
[54] Watson, Bibl. Ind. **1**: 416. 1878.
[55] Watson, Proc. Am. Acad. **22**: 475. 1887.

all the plants involved were regarded as conspecific. Coulter and Rose[56] in 1887 transferred the species to *Zizia*. In 1888 they[57] recognized the species as constituting a distinct and undescribed genus and so proposed the name *Aletes*.

2. **A. humilis** Coult. & Rose, Contr. U. S. Nat. Herb. **7:** 107. 1900; Rydb. Fl. Col. 253. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 352. 1909; Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922; Wolff, Pflanzenreich **90:** 141. 1927.

Pl. 25, fig. 38; pl. 28, fig. 2.

Plants 0.2–1 dm. high; leaves oblong in general outline, excluding the petiole, 1.5–4 cm. long, 1–3.5 cm. broad, simply or bi-pinnatisect, ultimate segments linear to ovate-oblong, acute, confluent in the bipinnatisect leaves, appearing as lobes of a leaflet, sometimes puberulent on the ribs and ciliate, 1–10 mm. long, 0.5–5 mm. broad, petiole 1–6 cm. long; peduncles shorter than the leaves, 1–4 cm. long, sometimes puberulent at the base of the umbel, rays of the umbel 20–45 mm. long, slender, lax, spreading, mostly glabrous, involucre absent, involucel bracts about equalling the flowers, linear, acute, sometimes ciliate; fruit ovate-oblong, 3–4 mm. long, about 2 mm. broad, ribs much reduced, in cross-section inconspicuous on the carpel surface, oil tubes solitary in the intervals, 2 on the commissure, accessory oil tubes absent.

Type specimen: *Osterhout 6*, Dale Creek, Larimer Co., Colorado, 19 July 1899 (TYPE in the United States National Herbarium, cotype in the New York Botanical Garden Herbarium).

Distribution: known only from the region of Dale Creek, Larimer Co., Colorado.

Specimens examined:

COLORADO: stony cliffs, Colo.-Wyo. line, April 1902, *Goodding 8850* (R); Dale Creek, Larimer Co., 19 July 1899, *Osterhout* (US 361576); Dale Creek, Larimer Co., 30 May 1901, *Osterhout* (PA 516511, US 735613); Dale Creek, Larimer Co., 19 July 1899, *Osterhout 6* (US TYPE, NY); on cliffs, Dale Creek, Larimer Co., 20 July 1898, *Osterhout 22* (NY); Dale Creek, Larimer Co., 19–20

[56] Coulter and Rose, Bot. Gaz. **12:** 137. 1887, in footnote.
[57] Coulter and Rose, Rev. N. Am. Umbell. 126. 1888.

July 1899, *Osterhout 2002* (G, R); Dale Creek, Larimer Co., 24 May 1912, *Osterhout 4678* (NY, R).

EXCLUDED SPECIES

A. (?) *Davidsoni* Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 107. 1900 = **Pseudocymopterus Davidsoni** (Coult. & Rose) Mathias, new comb.

A. (?) *MacDougali* Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 107. 1900 = **Oreoxis MacDougali** (Coult. & Rose) Rydb. Bull. Torr. Bot. Club **40**: 68. 1913.

A. (?) *tenuifolia* Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 108. 1900 = **Musineon lineare** (Rydb.) Mathias, Ann. Mo. Bot. Gard. **17**: 265. 1930.

VII

OREOXIS Raf.

The genus *Oreoxis* was described by Rafinesque[58] in 1830 and based on a plant collected by Dr. Edwin P. James in the "Rocky Mts." in the summer of 1820. Torrey[59] in the account of the James collections recognized and described this plant as a new "Umbellifera" but failed to give it a generic name. Rafinesque gave the name *Oreoxis* to "le genre *Anonymus*, n. 179, de Torrey." The number, *179*, does not refer to the James plant; but it is the serial number in Torrey's list of the James collection and refers to *Heracleum Sphondylium* in the list. The description of the new "Umbellifera" follows in an observation and no number is given to it. The type specimen in the New York Botanical Garden Herbarium was examined in connection with this study. It is doubtfully referred to "*Musenium divaricatum*," and the herbarium label has a Latin description of the plant, which, however, does not pertain to *M. divaricatum* but to *Oreoxis humilis*.

The generic name *Oreoxis* was first mentioned in a letter sent by Rafinesque to de Candolle; this letter was published in Ser-

[58] Rafinesque, in Seringe, Bull. Bot. **1**: 217. 1830.

[59] Torrey, in "Some Account of a Collection of Plants made during a journey to and from the Rocky Mountains in the summer of 1820, by Edwin P. James, M.D. Assistant Surgeon U. S. Army . . . . Read December 11, 1826," Ann. Lyc. Nat. Hist. N. Y. **2**: 207. 1828, gave an excellent description of an umbelliferous plant in an observation following no. 179, *Heracleum Sphondylium*, but unfortunately failed to suggest a generic name.

inge's 'Bulletin Botanique' in Geneva in 1830. Rafinesque also mentioned the genera *Adorium*, *Lomatium*, and *Cymopterus*, and stated: "Ces quatre genres sont établis dans sa *Flora Mandanensis*." The 'Florula Mandanensis,' which according to Rafinesque[60] appeared in pamphlet form in 1817, was probably never published, as no reference to it has been found in any of the Rafinesquian bibliographies nor in any of the works of Rafinesque. An index to the 'Florula,' however, was published in the 'Atlantic Journal,' extra of no. 6, 1833, but no mention is made there of the name *Oreoxis*.

The genus is primarily alpine in habitat, occurring for the most part in the higher mountains of Colorado and Utah. The fruit is margined by broad linear to subovate wings of a firm corky structure and in cross-section is characterized by the usual presence of a solitary accessory oil tube in each dorsal wing. The plants are all caespitose and for the most part low-growing, forming dense mats on the alpine summits above timber-line. One species, *O. MacDougali*, is not alpine and occurs in canyons and on mesas in southeastern Utah and adjacent regions.

Oreoxis Raf. in Seringe, Bull. Bot. **1**: 217. 1830; Atlantic Jour. **1**: 145. 1832; Linnaea 8 (Litt.-Ber.): 81. 1833; Coult. & Rose, Rev. N. Am. Umbell. 22, 89. 1888; Engler & Prantl, Nat. Pflanzenf. **3**^{8}: 213. 1898; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 143. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 354. 1909; Clem. & Clem. Rocky Mt. Fl. 231. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 480. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 394. 1925 [Fl. Utah & Nev.].

Low, herbaceous, acaulescent, caespitose, glabrous or pubescent perennials from slender elongated roots. Leaves petiolate, thin, simply pinnatisect or bipinnatisect; ultimate leaf divisions 1–30 mm. long, 0.5–4 mm. wide; petioles slightly sheathing. Inflorescence subcompact, peduncle exceeding the leaves; involucre absent or rarely present; involucel bracts linear to obovate, entire or toothed, membranous; calyx teeth conspicuous; flowers whitish or yellow; stylopodium lacking. Fruit ovate-oblong to

[60] Rafinesque, Atlantic Jour. **8**: 207. 1833.

oblong, flattened slightly dorsally, usually somewhat boat-shaped; lateral and dorsal wings present, corky, broadly linear to subovate and slightly constricted near the body of the mericarp; oil tubes small, 1–5 in the intervals, 2–10 on the commissure, usually solitary in the dorsal wings; strengthening cells present at the base of the wing; seed face plane or slightly concave.

Type species: **Oreoxis humilis** Raf. in Seringe, Bull. Bot. **1**: 217. 1830.

KEY TO SPECIES

A. Involucel bracts linear, mostly entire, usually green.
  B. Plants mostly puberulent, wings of the fruit subovate in cross-section .... *1. O. alpina*
  BB. Plants mostly glabrous, wings of the fruit broadly linear in cross-section.
    C. Fruit oblong, somewhat boat-shaped, 3–5 mm. long; oil tubes 1–5, mostly 3, in the intervals; plants of the alpine regions in the vicinity of Pike's Peak .... *2. O. humilis*
    CC. Fruit oblong, not boat-shaped, 4–8 mm. long; oil tubes solitary in the intervals; plants of canyons and mesas in southeastern Utah and adjacent regions .... *3. O. MacDougali*
AA. Involucel bracts obovate, mostly 3-toothed, usually purplish-tinged .... *4. O. Bakeri*

1. O. alpina (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 144. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 354. 1909; Clem. & Clem. Rocky Mt. Fl. 231. 1914; Rydb. Fl. Rocky Mts. 617. 1917, and ed. 2. 617. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 394. 1925 [Fl. Utah & Nev.]. Pl. 22, fig. 6; pl. 29, fig. 1.

Cymopterus alpinus Gray, Am. Jour. Sci. II, **33**: 408. 1862; Port. & Coult. Syn. Fl. Col. 50. 1874; Wats. Bibl. Ind. **1**: 418. 1878, in part; Rothr. Rept. U. S. Geogr. Surv. Wheeler **6**: 133. 1878 [Pl. Wheeler.]; Coult. Man. Bot. Rocky Mt. 118. 1885; Tweedy, Fl. Yellowstone Nat. Park, 40. 1886.

Plants 1–17 cm. high, more or less puberulent; leaves oblong in general outline, excluding the petiole, 0.5–5 cm. long, 0.3–1.5 cm. broad, simply or bi-pinnatisect, ultimate segments mostly distinct, linear, acute, 2–30 mm. long, 1–2 mm. broad, petioles 1–7 cm. long; peduncles mostly exceeding the leaves, 0.5–15 cm. long, umbels several-rayed, rays 2–7 mm. long, involucre absent or rarely present as one inconspicuous linear bract, involucel

bracts several, linear, mostly ciliate, about equalling the yellow flowers; fruit oblong, boat-shaped, 3–6 mm. long, 2–4 mm. broad, the young fruit more or less pubescent, mature fruit glabrous, wings in cross-section subovate, narrowed at the base, obtuse to acuminate at the apex, oil tubes usually solitary in the intervals, 2–4 on the commissure.

Type specimen: *Parry 168*, "from the head-waters of Clear Creek, and the alpine ridges lying east of 'Middle Park'," Colorado, 6 June 1861 (TYPE in the Gray Herbarium of Harvard University, cotypes in the herbaria of the Missouri Botanical Garden and the New York Botanical Garden).

Distribution: mountains from Wyoming to northern New Mexico, central Colorado to eastern Utah.

Specimens examined:

WYOMING: Cummings, 31 July 1895, *A. Nelson 1431* (R, US); eastern slope of the Big Horn Mountains, headwaters of Clear Creek and Crazy Woman River, 7000–9000 ft. alt., 20 July–15 Aug. 1900, *Tweedy 3370* (NY).

COLORADO: alpine slopes, Mt. Ouray, 12,000 ft. alt., 20 Aug. 1901, *C. F. Baker 847* (G, M, MU, N, NY, US); dry, high & level ground near Granite –19 miles south, 22 May 1897, *Beattie* (WSC 16616); Mts., Leadville, 11,000 ft. alt., July 1894, *Bethel 36-7* (US); Flat Top Mts., 9000 ft. alt., 10 July 1894, *Bethel 36-8* (US); alpine summits of Sangre de Xto Range, Aug. 1874, *T. S. Brandegee 956* (M); Estes Park, 11,500 ft. alt., 13 Aug. 1906, *Cooper 122* (R); Twin Sister Mt., Estes Park, 11,500 ft. alt., 23 July 1904, *Cooper 252* (R); Estes Park, 12 Aug. 1904, *Cooper 275* (R); California Gulch, 12,500 ft. alt., 16 July 1873, *Coulter* (PA); above timber line, west Cameron Pass, 5 July 1894, *Cowen* (NY); mountains above Boreas, 12,000 ft. alt., 2 Aug. 1895, *Cowen* (NY, US 254780); among rocks, above timber, mountain northeast of Boreas, 12,000 ft. alt., 2 Aug. 1895, *Cowen 186* (US); among rocks above timber, mountain near Boreas, 12,000 ft. alt., 2 Aug. 1895, *Cowen 262* (G); Gray's Peak Trail, 13,300 ft. alt., 18 July 1892, *Crandall* (US 216824); Front Range, 11,500 ft. alt., 4 July 1896, *Crandall* (M); head-waters of Beaver Creek, 50 miles west of Fort Collins, 11,000–12,000 ft. alt., 19–20 July 1898, *Crandall* (R 13273); above timber, Cameron Pass, 12,000 ft. alt., 5 July

1894, *Crandall 27* (US); Beaver Creek, 9500–12,000 ft, alt., 17 July 1898, *Crandall 1435* (NY); Egeria Park, 6 July 1891, *Eastwood* (US 44696); Leadville, 19 June 1918, *Eastwood 7121* (US); alpine slopes of Mount Flora, Upper Clear Creek, 12,000 ft. alt., 22 Aug. 1874, *G. Engelmann* (M); alpine crests, "The Bluffs," Spicer, Larimer Co., 10 July 1903, *Goodding 1506* (NY, R, US); dry summits above trees, 15 July 1871, *Greene 549* (G); high alpine, Rocky Mts., Lat. 40°, 1862, *E. Hall* (F 456296); Rocky Mts., 1861, *E. Hall 33* (G); Rocky Mountain Alpine Flora, Lat. 39°–41°, 1862, *Hall & Harbour 213* (F, G, M, PA); Leadville, 10,000 ft. alt., May 1886, *E. T. Harper* (M 968755); Veta Pass, Sangre de Christo Range, 11,000 ft. alt., 9–16 June 1890, *Hicks & Hicks 104* (MU); James' Peak near Central City, 13,000 ft. alt., 26 July 1899, *Holm* (NY); Sierra Blanca, 1877, *Hooker & Gray* (G); Argentine Pass, 12,000 ft. alt., 10 July 1878, *M. E. Jones 816* (CH, NY); Twin Sisters Mt., Estes Park, 1929, *Kiener* (M); timber line, Long's Peak, 5 Aug. 1886, *Letterman* (M 774527); near Breckenridge, Summit Co., 12,000 ft. alt., Aug. 1901, *Mackenzie 2* (M, PA, R); Milner Pass, near Estes Park, 11,000 ft. alt., 21 June 1929, *Mathias 425* (M); Twin Sisters Mt., near Estes Park, 11,000 ft. alt., 23 June 1929, *Mathias 455* (M); near Leadville, last of June 1895, *Osterhout* (US 231796); mts. of Estes Park, Larimer Co., 22 July 1903, *Osterhout 2830* (R); mts. of Estes Park, Larimer Co., 19 Aug. 1905, *Osterhout 3102* (G, NY, R); Horsethief Trail, Ouray, Ouray Co., 25 July 1915, *Osterhout 5358* (R); in alpine meadow, Kingston Peak, 11,000 ft. alt., 7 July 1923, *Overholts, Roberts & Shope 184* (M); lat. 39°–41°, 1862, *Parry* (M); 1872, *Parry* (G, M 873274, NY); on high alpine ridges, head-waters of Clear Creek, and the alpine ridges lying east of "Middle Park," 6 June 1861, *Parry 158* (G TYPE, M, NY); Summit, Griffith, 28 June–7 Aug. 1875, *Patterson* (F 62568); high alpine, Georgetown, 1885, *Patterson* (G, M); high alpine summits, 11,000–13,000 ft. alt., 11 July–11 Aug. 1885, *Patterson* (CH 257177); high mountains, Gray's Peak and vicinity, 11,000–14,000 ft. alt., 6 July, 10 Aug. 1885, *Patterson 38* (F, G, MU, US); high mountains, Gray's Peak and vicinity, 11,000–14,000 ft. alt., Aug. 1885, *Patterson 39* (G, US); Georgetown, 1885, *Patterson 5390* (NY); vicinity of Gray's Peak, Aug. 1882,

Patterson & Beaty (F 96845); near 4th July Mine, 29 July 1906, *Ramaley & Robbins 2489* (R); Gray's Peak, Aug. 1895, *Rydberg* (NY); mountain near Veta Pass, 3000 m. alt., 20 June 1900, *Rydberg & Vreeland 5812* (NY, R, US); near Leadville, June, *Schedin & Schedin 296* (R); Alpine Tunnel, 11,000 ft. alt., 17 July 1897, *Shear 3851* (NY); Gray's Peak, 13,000–14,000 ft. alt., 23 Aug. 1895, *Shear 4648* (NY, US); above timber, Leadville, 7 July 1886, *Trelease* (M); Berthoud Pass, Grand Co., 11,000–12,000 ft. alt., July 1903, *Tweedy 5603* (NY, R); Rocky Mountains, Lat. 40°–41°, 1868, *Vasey 221* (G, M); Sapinero, 1898, *Wheeler 468* (R); *Wolf* (F 91886); Georgetown, 1873, *Wolf 725* (G, NY); 1873, *Wolf 731* (*160*) (G, US); above snow line, 1873, *Wolf & Rothrock 852* (G).

New Mexico: Ft. Wingate, 25 May 1883, *Marsh 22* (US); 1869, *E. Palmer 40* (G, US).

Utah: gravel, Mt. Ellen, Henry Mts., 11,000 ft. alt., 25 July 1894, *M. E. Jones 5669* (M, NY, US); Bromide Pass, Henry Mts., 10,000 ft. alt., 27 July 1894, *M. E. Jones 5695r* (US); U. M. Creek near Fish Lake, 9000 ft. alt., 11 Aug. 1894, *M. E. Jones 5826b* (US); slide rock, La Sal Mts., Grand Co., 11,500 ft. alt., 27 July 1924, *Payson & Payson 4038* (R); Abajo Mountains (eastern range), 3000–3300 m. alt., 17 Aug. 1911, *Rydberg & Garrett 9756* (NY); 1874, *Siler* (G); rocky slopes, La Sal Mts., Grand Co., 11,500 ft. alt., 15 July 1912, *Walker 269* (G, MU, R, US).

2. **O. humilis** Raf. in Seringe, Bull. Bot. **1**: 217. 1830; Atlantic Jour. **1**: 145. 1832; Linnaea **8** (Litt.-Ber.): 81. 1833; Coult. & Rose, Rev. N. Am. Umbell. 89. 1888, in part; Nels. Fl. Wyo. 117. 1896, name only; Heller, Cat. N. Am. Plants, 98. 1898, and ed. 2. 151. 1900; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 143. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 354. 1909; Clem. & Clem. Rocky Mt. Fl. 231. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 480. 1915 [Fl. New Mex.], name only; Rydb. Fl. Rocky Mts. 616. 1917, and ed. 2. 616. 1922.

Cymopterus alpinus Gray acc. to Wats. Bibl. Ind. **1**: 418. 1878, in part as to synonym *O. humilis*.

Plants 2–15 cm. high, mostly glabrous except for an occasional puberulence at the base of the umbel and in the inflorescence; leaves oblong in general outline, excluding the petiole, 0.5–4.5 cm. long, 0.5–1 cm. broad, simply or bi-pinnatisect, ultimate segments mostly distinct, linear, acute, 2–10 mm. long, 1–2 mm. broad, petioles 1–4.5 cm. long; peduncles exceeding the leaves, 1–13 cm. long, umbels several-rayed, rays 2–5 mm. long, involucre absent, or rarely present as one inconspicuous linear bract, involucel bracts several, linear, about equalling the yellow flowers; fruit oblong, somewhat boat-shaped, 3–5 mm. long, 1.5–3 mm. broad, wings in cross-section broadly linear, lateral wings broader than the dorsals, mostly rounded at the apex, oil tubes 1–5, usually 3, in the intervals, 3–6 on the commissure.

Type specimen: *James*, "Rocky Mts.," Colorado, 1820 (TYPE in the New York Botanical Garden Herbarium, photograph of the type in the Missouri Botanical Garden Herbarium).

Distribution: Colorado, alpine regions of Pike's Peak.

Specimens examined:

COLORADO: Pike's Peak, 13,000 ft. alt., 27 July 1895, *E. A. Bessey* (NY); Pike's Peak, 12,000 ft. alt., 6 Aug. 1895, *E. A. Bessey* (NY); Pike's Peak, 13,000 ft. alt., 25 July 1896, *E. A. Bessey* (NY); s. slope, Pike's Peak, 14,000 ft. alt., 2 Aug. 1903, *Blumer* (G); Pike's Peak, 13,000 ft. alt., 13 Aug. 1912, *Brumbach & Davies 104b* (F); Pike's Peak, 27 Aug. 1895, *Canby* (US 233843); Pike's Peak, Colorado Springs, 13,000 ft. alt., 24 June 1912, *Churchill* (M 782195, 838433); Mount Garfield, 1900, *F. Clements* (NY); Peak Slope, 3900 m. alt., 8 July 1901, *Clements & Clements 435* (G, M, MU, NY, R, US); Mount Garfield, 3850 ft. alt., 15 July 1901, *Clements & Clements 513* (G, M, MU, NY, R, US); Pike's Pk., July 1892, *Eastwood* (US 44695); Pike's Peak, 20 July 1892, *Eastwood* (NY); Pike's Peak, 12,000 ft. alt., 28 June 1925, *Fisher 283* (US); Pike's Peak, 1878, *Harmbach* (M); The Saddle, Pike's Peak, July 1900, *Harper & Harper* (M 968752); Saddle House, Pike's Peak, 12,000 ft. alt., 15 July 1900, *Harper & Harper* (M 969809); The Saddle, Pike's Peak Trail, 29 July 1900, *Harper & Harper* (M 968754); Seven Lakes, Aug. 1900, *Harper & Harper* (M 969957); The Saddle, Pike's Peak Trail, 6 Aug. 1900, *Harper & Harper* (M 968753); along the Cogg Wheel Rail-

way, Pike's Peak, 12,000–14,000 ft. alt., 7 June 1896, *Holzinger 9* (US); Rocky Mts., 1820, *James* (NY TYPE, M photograph); Saddle House, Pike's Peak, 12,500 ft. alt., 14 June 1896, *Knowlton 20* (NY, US); Pike's Peak, 13,000 ft. alt., 13 Aug. 1884, *Letterman 177* (CH, M, NY); above timber line, Pike's Peak, 8 Aug. 1884, *Letterman 223* (M); above timber line, Pike's Peak Trail, 13,000 ft. alt., 13 Aug. 1884, *Letterman 223* (M, US); Pike's Peak, El Paso Co., 25 Aug. 1915, *Osterhout 5383* (GO, R); Windy Point, Pike's Peak, 13,000 ft. alt., 2 Aug. 1919, *E. B. Payson 1579* (R); Pike's Peak, 12,000 ft. alt., June 1891, *Penard* (NY); Pike's Peak, 14,000 ft. alt., 28 Aug. 1884, *Sheldon 311* (US); Pike's Peak, 10 July 1901, *C. S. Williamson* (PA).

3. **O. MacDougali** (Coult. & Rose) Rydb. Bull. Torr. Bot. Club **40**: 68. 1913; Fl. Rocky Mts. 617. 1917, and ed. 2. 617. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 394. 1925 [Fl. Utah & Nev.]; Wolff, Pflanzenreich **90**: 142. 1927. Pl. 30, fig. 1.

Aletes (?) MacDougali Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 107. 1900.

Plants 8–20 cm. high, glabrous; leaves oblong in general outline, excluding the petiole, 0.5–8 cm. long, 0.5–3 cm. broad, mostly simply pinnate, occasionally bipinnatisect, ultimate segments distinct, linear, acute (in bipinnatisect leaves somewhat confluent, appearing as cuneate to obovate, lobed leaflets), 2–30 mm. long, 1–4 mm. broad, petioles 1–11 cm. long; peduncles exceeding the leaves, 5–15 cm. long, umbels several-rayed, rays 3–17 mm. long, involucre absent, involucel bracts several, linear, about equalling the yellow flowers; fruit oblong, 4–8 mm. long, 1–5 mm. broad, wings in cross-section broadly linear, rounded or acute, oil tubes solitary in the intervals, 2 on the commissure.

Type specimen: *MacDougal 192*, "on Berry's trail to the Grand Canyon of the Colorado, Arizona," 7000 ft. alt., 28 June 1898 (TYPE in the United States National Herbarium, cotypes in the herbaria of the Brooklyn Botanic Garden, Field Museum of Natural History, and the New York Botanical Garden and the Gray Herbarium of Harvard University, photograph of the type in the Missouri Botanical Garden Herbarium).

Distribution: canyons and mesas of southeastern Utah, adjacent Arizona and Colorado.

Specimens examined:

Colorado: between top of cliff and Needle's Eye on way to Square Tower House, Mesa Verde National Park, 8 July 1929, *Mathias 637* (M); along cliffs below camp ground, Spruce Canyon, Mesa Verde National Park, 8 July 1929, *Mathias 650* (M); on cliff on trail to pictographs on west-facing slope near mouth of Spruce Cañon, Mesa Verde National Park, 6800 ft. alt., 16 June 1925, *Schmoll 1749* (R).

Utah: Courthouse Wash, 16 June 1913, *M. E. Jones* (P 83107); Armstrong and White Canyons, near the Natural Bridges, 1600–1800 m. alt., 4–6 Aug. 1911, *Rydberg & Garrett 9456* (NY); Armstrong and White Canyons, near the Natural Bridges, 1600–1800 m. alt., 4–6 Aug. 1911, *Rydberg & Garrett 9458* (NY, US).

Arizona: Berry's Trail, Grand Canyon, 7000 ft. alt., 28 June 1898, *MacDougal 192* (US type, B, F, G, M photograph, NY).

This species, originally referred questionably to *Aletes* by Coulter and Rose, is undoubtedly better placed in *Oreoxis* because of the fruit structure. Mature well-developed fruit is apparently rarely produced, a condition occurring in certain other species of the family. However, the mature fruit when produced is that typical for the genus *Oreoxis* in the corky development of the wings, oil-tube number, position, etc.

The type specimen, *MacDougal no. 192*, shows a slight tendency toward a caulescent condition in certain cases, but this tendency is apparently a rare development and does not appear in the other material. *Mathias no. 650* is a much attenuated form of the species with conspicuously elongated leaf segments but intermediates occur in the same colony.

Further collections from the mesas and canyons of northeastern Arizona and adjacent Utah, Colorado, and New Mexico will doubtless extend the range of this species and give it a more continuous distribution than that now known.

4. **O. Bakeri** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 144. 1900; Rydb. Fl. Col. 252. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 354. 1909; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 480. 1915 [Fl. New Mex.], excluding *no. 4318;* Rydb.

Fl. Rocky Mts. 617. 1917, and ed. 2. 617. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 394. 1925 [Fl. Utah & Nev.].

Pl. 29, fig. 2.

Cymopterus Bakeri (Coult. & Rose) Jones, Contr. West. Bot. 12: 28. 1908.

Plants 1–12.5 cm. high, glabrous except for a slight puberulence at the base of the umbel and on the rays; leaves narrowly oblong in general outline, excluding the petiole, 0.5–5 cm. long, 0.3–2 cm. broad, mostly bipinnatisect, ultimate segments linear, acute, sometimes mucronulate, more or less distinct, 1–7 mm. long, 0.5–2 mm. broad, petioles 0.5–5 cm. long; peduncles usually exceeding the leaves, 1.5–11 cm. long, umbels several-rayed, rays 3–5 mm. long, involucre mostly absent, involucel bracts conspicuous, about equalling the yellow or whitish flowers, obovate, mostly 3-toothed (varying from 2 to 5) at the apex, greenish or purplish-tinged; fruit ovate-oblong, 3–4 mm. long, 2–3.5 mm. broad, usually purplish-tinged, wings in cross-section mostly linear, rounded to subacute at the apex, oil tubes 3–4 in the intervals, 5–10 on the commissure.

Type specimen: *C. F. Baker 12*, frequent on high, bald summits, mts. near Pagosa Peak, Colorado, 23 Aug. 1899 (TYPE in the United States National Herbarium).

Distribution: high mountains of southern Colorado and adjacent New Mexico and Utah.

Specimens examined:

COLORADO: frequent on high, bald summits, mts. near Pagosa Peak, 23 Aug. 1899, *C. F. Baker 12* (US TYPE); near Pagosa Peak, 12,000 ft. alt., Aug. 1899, *C. F. Baker 505* (G, M, N, NY, R); Mount Ouray, 12,000 ft. alt., 20 Aug. 1901, *C. F. Baker 856* (G, M, MU, N, NY, US); Mt. Hayden, 13,000 ft. alt., 14 July 1898, *Baker, Earle & Tracy 577* (NY, R, US); alpine summits of Sangre de Xto Range, Aug. 1874, *T. S. Brandegee 955* (M); among rocks, near Trout Lake, San Miguel Co., 12,200 ft. alt., 21 Aug. 1924, *Payson & Payson 4206* (G, R); West Spanish Peak, 3000–3800 m. alt., 9 July 1900, *Rydberg & Vreeland 5809, 5810* (NY); West Spanish Peak, 2800–3000 m. alt., 6 July 1900, *Rydberg & Vreeland 5811* (NY); Cumberland Basin, La Plata Mountains, 12,000 ft. alt., July 1896, *Tweedy 93* (US); La Plata Mts., 12,000 ft. alt., 15 July 1896, *Tweedy 493* (US).

NEW MEXICO: Lake Peak, vicinity of Santa Fe, 3700 m. alt., 12 Aug. 1926, *Arsène & Benedict 16135* (US); top of Pecos Baldy, 12,600 ft. alt., 31 July 1903, *Bailey 631* (US); top of Las Vegas Range, above Sapello Creek, 11,000 ft. alt., *T. D. A. Cockerell* (US 660065); top of Las Vegas Range, 11,000 ft. alt., end of June 1901, *T. D. A. Cockerell 25* (R); above timber line, Baldy Peak, Colfax Co., about 3600 m. alt., 4 Sept. 1916, *Standley 14341* (US).

UTAH: exposed alpine meadow, Mt. Tomasaki, La Sal Mountains, 12,500 ft. alt., 14 June 1914, *E. B. Payson 414* (G, M, R); La Sal Mountains, 3300–3600 m. alt., 7 July 1911, *Rydberg & Garrett 8694, 8697, 8698* (NY); La Sal Mountains, 3300–3600 m. alt., 7 July 1911, *Rydberg & Garrett 8695* (G, M, MU, NY); West Mt. Peal, La Sal Mountains, 3300 m. alt., 10 July 1911, *Rydberg & Garrett 8790* (NY); Gold Basin, La Sal Mountains, 3000–3300 m. alt., 11 July 1911, *Rydberg & Garrett 8840* (NY); La Sal Mountains, near Mount Peal, 3300–3700 m. alt., 17 July 1911, *Rydberg & Garrett 9016* (NY); La Sal Mountains, near Mount Peal, 3300–3700 m. alt., 17 July 1911, *Rydberg & Garrett 9017* (NY, R, US).

VIII

COGSWELLIA Spreng.

Cogswellia Spreng. in Linn. Syst. Veg., ed. Roem. & Schult., **6**: XLVIII. 1820; Britt. & Brown, Ill. Fl. **2**: 631. 1913; Piper & Beattie, Fl. N. W. Coast, 260. 1915; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 484. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 624. 1917, and ed. 2. 624. 1922.

Peucedanum of American authors, non [Tourn.] L.; Nutt. Gen. **1**: 181. 1818; DC. Prodr. **4**: 176. 1830, as to Am. spp.; Torr. & Gray, Fl. N. Am. **1**: 625. 1840; Walp. Rep. Bot. Syst. **2**: 409. 1843, as to Am. spp.; Benth. & Hook. Gen. Pl. **1**: 918. 1867, as to Am. spp. in part; Wats. Bibl. Ind. **1**: 427. 1878; Coult. Man. Bot. Rocky Mt. 119. 1885; Coult. & Rose, Rev. N. Am. Umbell. 20, 53. 1888; Coult. Contr. U. S. Nat. Herb. **2**: 142. 1891; Howell, Fl. N. W. Am. **1**: 251. 1898; Drude in Engler & Prantl, Nat. Pflanzenf. **3**^{8}: 234. 1898, as to Am. spp.

Lomatium Raf. Jour. Phys. **89**: 101. 1819, non *Lomatia* R. Br. in Trans. Linn. Soc. Bot. **10**: 199. 1810; Coult. & Rose, Contr. U.

S. Nat. Herb. **7**: 204. 1900; Piper, Contr. U. S. Nat. Herb. **11**: 419. 1906 [Fl. Wash.]; Gray, Man. ed. 7, 619. 1908; Jeps. Man. Fl. Pl. Calif. 719. 1925.

"*Cogswellia* Raf." acc. to Coult. & Nels. Man. Bot. Cent. Rocky Mts. 362. 1909; Tidestrom, Contr. U. S. Nat. Herb. **25**: 400. 1925 [Fl. Utah & Nev.].

The type species of the genus is *Cogswellia villosa* (Raf.) Spreng. in Linn. Syst. Veg., ed. Roem. & Schult., **6**: XLVIII. 1820, which equals **C. foeniculacea** (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 449. 1909.

Synonyms:

Ferula foeniculacea Nutt. Gen. **1**: 183. 1818.

Lomatium villosum Raf. Jour. Phys. **89**: 101. 1819.

Pastinaca foeniculacea (Nutt.) Spreng. in Linn. Syst. Veg., ed. Roem. & Schult., **6**: 587. 1820.

Cogswellia villosa (Raf.) Schult. in Linn. Syst. Veg., ed. Roem. & Schult., **6**: 588. 1820.

Lomatium pubescens Raf. in Seringe, Bull. Bot. **1**: 216. 1830; Raf. Atlantic Jour., extra of number 6: 40. 1833.

Peucedanum foeniculaceum Nutt. in Torr. & Gray, Fl. N. Am. **1**: 627. 1840.

Lomatium foeniculaceum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 222. 1900.

The historical type on which *Cogswellia* was based is a plant collected by Bradbury on the Missouri and named *Lomatium villosum* by Rafinesque. Bradbury and Nuttall collected together in the upper Missouri in the region which is now Nebraska and South Dakota. Rafinesque described some of Bradbury's plants, among them *Ferula foeniculacea.* These two have since been regarded as conspecific, and a study of the historical material at hand substantiates this view. The Nuttall plant which was collected "On the high plains of the Missouri, commencing about the confluence of the river Jauke" [James River, South Dakota] is said by Coulter and Rose not to be "in Herb. Philad. Acad., and possibly lost." However, herbarium specimens from the Philadelphia Academy of Natural Sciences which were labeled "*Cymopterus glomeratus* Raf. (*Thapsia* Nutt.)," collected in Louisiana by Bradbury and Nuttall, and supposedly a part of the

type material of *Cymopterus*, were kindly loaned for this study, and upon critical examination proved not to be *Cymopterus* but correspond well with the original characterization of *Lomatium* and probably represent the missing type of that genus.

A careful examination of a large amount of widely distributed material of European and American plants previously referred to *Peucedanum* substantiates conclusions reached by various students of the Umbelliferae that the American plants differ from the true *Peucedanum* of Europe in several important morphological characters, particularly in the absence of a stylopodium, in the usually single umbels terminating simple elongated peduncles, and in the number and disposition of the oil tubes in the fruit.

The name *Cogswellia* was proposed by Sprengel in 1820 for the *Lomatium* of Rafinesque, as that name was antedated by a *Lomatia* of Robert Brown. Recent workers have used both *Cogswellia* and *Lomatium* for these species which are congeneric with the *Peucedanum* of American authors, but not of Linnaeus.

The name *Lomatium* was reinstated in 1918 by Macbride[61] who justified its use by quoting Article 57 of the International Rules of Botanical Nomenclature, which reads in part: "When the difference between two names, especially two generic names, lies in the termination, these names are to be regarded as distinct even though differing by one letter only." However, it is felt that this is not a sufficiently valid reason for retaining both *Lomatium* and *Lomatia* and that such retention would be a source of permanent confusion. Article 51, part 4, covers this case by saying that every one should refuse to admit a name "when it becomes a permanent source of confusion and error."

The genus *Cogswellia* is, in the Grayian sense of the word, "polymorphic." It represents a greatly varying group and one of wide distribution in the western part of North America, extending fron Saskatchewan and British Columbia to Mexico, and from western Missouri to California.

The most important diagnostic character in distinguishing the genus from other genera under consideration is in the fruit which is ovate-oblong, varying in length, glabrous or pubescent, flattened dorsally, and distinctly winged on the dorsal wings only. The

[61] Macbride, Contr. Gray Herb. N. S. 53: 15. 1918.

inflorescence is spreading and the peduncles usually much exceed the leaves.

Representative species of the genus are *Cogswellia ambigua* (Nutt.) Jones, *C. dasycarpa* (Torr. & Gray) Jones, *C. Grayi* Coult. & Rose, *C. macrocarpa* (Nutt.) Jones, *C. nudicaulis* (Pursh) Jones, *C. triternata* (Pursh) Jones, and *C. utriculata* (Nutt.) Jones.

IX

PSEUDOCYMOPTERUS Coult. & Rose

Pseudocymopterus Coult. & Rose, Rev. N. Am. Umbell. 20, 74. 1888; Howell, Fl. N. W. Am **1**: 258. 1898; Engler & Prantl, Nat. Pflanzenf. **3**[8]: 222. 1898; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 187. 1900; Rydb. Fl. Col. 256. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 360. 1909; Nels. Spring Fl. Intermt. States, 119. 1912; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 482. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 399. 1925 [Fl. Utah & Nev.].

Pseudopteryxia Rydb. Bull. Torr. Bot. Club **40**: 71. 1913; Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922.

Pseudoreoxis Rydb. Bull. Torr. Bot. Club **40**: 73. 1913; Fl. Rocky Mts. 621. 1917, and ed. 2. 621. 1922.

Herbaceous, acaulescent or caulescent, caespitose, glabrous or pubescent perennials from long slender tap-roots. Leaves petiolate, thin, simply to tri-pinnatisect; ultimate leaf divisions 0.1–11 cm. long, narrow; petioles somewhat sheathing. Inflorescence subglobose to spreading, peduncles exceeding the leaves; involucre mostly absent, involucel present, mostly dimidiate; flowers white, purple or yellow; calyx teeth conspicuous; stylopodium lacking. Fruit narrowly oblong to ovate-oblong, flattened dorsally or subterete; lateral wings present; dorsal wings similar to the laterals or absent through abortion; wings mostly thin, sublinear in cross-section; oil tubes 1–8 in the intervals, 2–8 on the commissure, sometimes present in the wing base; strengthening cells absent or present; seed face slightly concave.

Type species: **Pseudocymopterus montanus** (Gray) Coult. & Rose, Rev. N. Am. Umbell. 74. 1888.

KEY TO SPECIES

A. Plants caulescent.
  B. Stems few-leaved; fruit ovate to ovate-oblong, 3–7 mm. long, 2–4 mm. broad .... *1. P montanus*
  BB. Stems mostly many-leaved; fruit oblong, 3–4 mm. long, 1–2 mm. broad .... *2. P. Davidsoni*
AA. Plants acaulescent.
  C. Leaves glabrous except for an occasional pubescence on the veins and nodes.
    D. Ultimate leaf segments mostly appearing as lobes of a subcuneate leaflet; rays of the umbel conspicuously unequal; dorsal wings of the fruit aborted .... *3. P. anisatus*
    DD. Ultimate leaf segments distinct, mostly linear; rays of the umbel subequal; dorsal wings of the fruit usually developed.
      F. Involucel bracts prominent, mostly exceeding the yellow flowers; calyx teeth conspicuous .... *4. P. Hendersoni*
      FF. Involucel bracts not prominent; calyx teeth not conspicuous.
        G. Umbels few-rayed, mature rays less than 5 mm. long. .... *5. P. humboldtensis*
        GG. Umbels several-rayed, mature rays over 5 mm. long .. *1. P. montanus*
  CC. Leaves rough-puberulent.
    E. Leaves bi-tri-pinnatisect, ultimate segments crowded; rays of the umbel 1–17 mm. long .... *6. P. bipinnatus*
    EE. Leaves simply or bi-pinnatisect, ultimate segments not crowded; rays of the umbel less than 5 mm. long .... *7. P. nivalis*

1. P. montanus (Gray) Coult. & Rose, Rev. N. Am. Umbell. 74. 1888; Heller, Cat. N. Am. Pl. 98. 1898, and ed. 2. 151. 1900; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 188. 1900; Rydb. Fl. Col. 256. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 483. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 399. 1925 [Fl. Utah & Nev.]. Pl. 25, figs. 4–13; pls. 32–33.

Thaspium (?) montanum Gray, Mem. Am. Acad. N. S. **4**: 57. 1849 [Pl. Fendl.]; Torr. Bot. Whipple's Exp. 38. 1857.

T. (?) montanum var. *(?) tenuifolium* Gray, Smiths. Contr. **5**: 65. 1853 [Pl. Wright. **2**: 65. 1853].

Ligusticum montanum (Gray) Benth. in Benth. & Hook. Gen. Pl. **1**: 912, 914. 1867; Port. & Coult. Syn. Fl. Col. 51. 1874; Rothr. Rept. U. S. Geogr. Surv. Wheeler **6**: 134. 1878 [Pl. Wheeler.]; Wats. Bibl. Ind. **1**: 426. 1878; Coult. Man. Bot. Rocky Mt. 117. 1885.

Peucedanum Lemmoni Coult. & Rose, Bot. Gaz. **14**: 277. 1889; Heller, Cat. N. Am. Pl. 98. 1898, and ed. 2. 152. 1900.

Ligusticum montanum var. *tenuifolium* (Gray) Wats. Bibl. Ind. **1**: 426. 1878.

Pseudocymopterus montanus var. *tenuifolius* (Gray) Coult. & Rose, Rev. N. Am. Umbell. 75. 1888; Contr. U. S. Nat. Herb. **7**: 188. 1900.

P. montanus var. *purpureus* Coult. & Rose, Rev. N. Am. Umbell. 75. 1888; Heller, Cat. N. Am. Pl. 98. 1898, and ed. 2. 151. 1900; Coult & Rose, Contr U. S. Nat. Herb. **7**: 189. 1900.

"*P. montanus* var. *tenuifolius* (Wats.) Coult. & Rose" acc. to Heller, Cat. N. Am. Pl. 98. 1898, and ed. 2. 151. 1900.

Lomatium Lemmoni Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 231. 1900.

Pseudocymopterus sylvaticus Nels. Bull. Torr. Bot. Club **28**: 224. 1901; Rydb. Fl. Col. 257. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909; Daniels, Fl. Boulder, Col. 185. 1911; Rydb. Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922.

P. montanus var. *multifidus* Rydb. Bull. Torr. Bot. Club **31**: 574. 1904.

P. multifidus Rydb. Bull. Torr. Bot. Club **33**: 147. 1906; Fl. Col. 257. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909; Daniels, Fl. Boulder, Col. 185. 1911; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 483. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922.

P. purpureus (Coult. & Rose) Rydb. Bull. Torr. Bot. Club **33**: 147. 1906; Fl. Col. 257. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 482. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 399. 1925 [Fl. Utah & Nev.].

P. tenuifolius (Gray) Rydb. Bull. Torr. Bot. Club **33**: 147. 1906; Fl. Col. 257. 1906; Coult & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 483. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922.

Cymopterus ligusticoides Jones, Contr. West. Bot. 12: 29. 1908.

C. ligusticoides var. *tenuifolius* (Gray) Jones, Contr. West. Bot. 12: 29. 1908.

Cogswellia Lemmoni (Coult. & Rose) Jones, Contr. West. Bot. 12: 33. 1908; Coult. & Rose, Contr. U. S. Nat. Herb. **12:** 450. 1909.

Pseudocymopterus Tidestromii Coult. & Rose, Contr. U. S. Nat. Herb. **12:** 447, *pl. 83.* 1909; Rydb. Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25:** 399. 1925 [Fl. Utah & Nev.].

P. versicolor Rydb. Fl. Rocky Mts. 623, 1064. 1917, and ed. 2. 623. 1922.

Plants caulescent or acaulescent, 0.5–8.5 dm. high from a long slender tap-root; leaves ovate-oblong to broadly ovate in general outline, excluding the petiole, 1–17 cm. long, 1–14 cm. broad, simply pinnate to tripinnatisect, occasionally scaberulent, especially at the nodes, sometimes ciliate, ultimate segments filiform to broadly lanceolate, acute, remote or more or less confluent, 0.1–11 cm. long, 0.5–11 mm. broad, petiole somewhat sheathing at the base, occasionally with scarious or purple margins, 1–24 cm. long; peduncles usually exceeding the leaves, hirtellous-pubescent at the base of the umbel, umbels several-rayed, rays sometimes scaberulent, 3–55 mm. long, involucre absent or rarely present in the form of one or two lanceolate bracts, involucel bracts shorter than or exceeding the yellow, orange-purple, or purple flowers, sometimes scarious-margined or purplish-tinged, filiform to narrowly elliptic, acute at the apex and occasionally tapering to the base; fruit ovate to ovate-oblong, 3–7 mm. long, 2–4 mm. broad, lateral wings present, linear to triangular in cross-section, acute, dorsal wings usually 1–3, similar to the laterals, or reduced to conspicuous ribs or obsolete, oil tubes 1–5 in the intervals, or, when the dorsal ribs are obsolete, about 15 on the dorsal surface, 2–6, usually 4, on the commissure, rarely occurring at the base of the wing, strengthening cells absent or present.

Type specimen: *Fendler 276*, "Sunny declivities, at the foot of mountains, along Santa Fe Creek," New Mexico, April–July 1847 (TYPE in the Gray Herbarium of Harvard University, cotypes in the herbaria of the Missouri Botanical Garden, New

York Botanical Garden, Academy of Natural Sciences, Philadelphia, and the United States National Museum).

Distribution: mountainous regions from southern Wyoming to Durango, Mexico, and eastern New Mexico west to western Utah.

Specimens examined:

TEXAS: Livermore Peak & spur ridges, Davis Mts., Jeff Davis Co., 9–12 July 1921, *Ferris & Duncan 2557* (M, NY); clefts and crevices of porphyritic rocks, near Mt. Livermore, Davis Mountains, Jeff Davis Co., 2200 m. alt., 11 June 1926, *E. J. Palmer 30788* (M).

WYOMING: Hog Park, Hayden Forest, Carbon Co., 2500 m. alt., 10 July 1915, *Eggleston 11331* (US); Medicine Bow Range, 9500 ft. alt., June 1902, *Kemp* (NY); Laramie Hills, 23 May 1895, *A. Nelson 1238* (US); Saw Mill Creek, 25 May 1895, *A. Nelson 1238* (G, M, MU, R, US); damp woods, Tie City, 20 July 1900, *A. Nelson 7667* (NY); wooded, wet bottom lands, Tie City, Albany Co., 20 July 1900, *A. Nelson 7667* (G, M, MU, NY, P, R, US); mts., 3 Sept. 1897, *Osterhout* (MU 164827).

COLORADO: near Breckenridge, 22 July 1906, *J. P. Anderson* (M 718573); near Cameron Pass, 9500 ft. alt., 7 July 1894, *C. F. Baker* (P 100184); Cameron Pass, 10,000 ft. alt., 13 July 1896, *C. F. Baker* (M, N 21149, NY, P 100181); Los Pinos, May 1899, *C. F. Baker* (F 123016, G, M, N 20607, NY, P 100172, R, US 370977); hillsides and bottoms, especially in moist places, Los Pinos, 29 May 1899, *C. F. Baker* (PA); Piedra, July 1899, *C. F. Baker* (M, NY, P 100173, US 370981); Pagosa Springs, July 1899, *C. F. Baker* (P 100170); frequent in oak thickets, Piedra, 13 July 1899, *C. F. Baker* (PA); Cameron Pass, 10,000 ft. alt., 13 July 1896, *C. F. Baker 5* (US); road up west Mancos, 8000–9000 ft. alt., 26 April 1898, *C. F. Baker 137* (US); near Pagosa Peak, 9000 ft. alt., Aug. 1899, *C. F. Baker 508* (F, G, M, NY, R, US); Keblar Pass, 9500 ft. alt., 14 Aug. 1901, *C. F. Baker 789* (WSC); common in open places, Keblar Pass, 10,000 ft. alt., 14 Aug. 1901, *C. F. Baker 789* (G, M, MU, N, NY, P, R, US); Mount Ouray, 11,500 ft. alt., 20 Aug. 1901, *C. F. Baker 859* (NY, P); Marshall Pass, 20 Aug. 1901, *C. F. Baker 877* (N); abundant on bare summits, Cumberland Basin, La Plata Mts., 12,300 ft. alt., 15 July 1898, *Baker, Earle & Tracy* (NY); hills

above Mancos, 8000–9000 ft. alt., 26 June 1898, *Baker, Earle & Tracy 137* (F, G, M, MU, NY, P, R, US); abundant on bare summits, Cumberland Basin, La Plata Mts., 12,300 ft. alt., 15 July 1898, *Baker, Earle & Tracy 619* (G, M, MU, NY, P, R, US); Cumberland Mine, La Plata Mts., 12,300 ft. alt., 15 July 1898, *Baker, Earle & Tracy 619* (CH, F, N); Mancos, 22 June 1898, *Baker, Earle & Tracy 848* (NY, P); northeast corner of North Park, 5 Aug. 1874, *E. A. Barber* (US 582216); along Grand River, Middle Park, Aug. 1892, *Beardslee 125* (US); Stonewall, Aug. 1917, *F. Beckwith 149* (NY); Williams Cañon, neighborhood of Pike's Peak, 19 July 1894, *E. A. Bessey* (NY); Seven Lakes, neighborhood of Pike's Peak, 20 July 1895, *E. A. Bessey* (NY); Minnehaha, 8000 ft. alt., 31 July 1895, *E. A. Bessey* (NY); Engelmann Cañon, 15 July 1896, *E. A. Bessey* (NY); mts., Leadville, 11,000 ft. alt., 1 July 1894, *Bethel 36–5* (US); Gore Mts., 9500 ft. alt., Aug. 1895, *Bethel 36–18* (US); vicinity of Pike's Peak, 23 June 1896, *Biltmore Herbarium 1* [*302*] (US 980768); 1874, *T. S. Brandegee 953* (M); alpine in Sangre de Cristo Range, Aug. 1874, *T. S. Brandegee 958* (M); Table Rock, 7500 ft. alt., 6 June 1895, *Breninger 3* (US); Pike's Peak, 12,000 ft. alt., 13 Aug. 1912, *Brumbach & Davies 105* (F); mts., Aug. 1871, *Canby* (G); Bear Creek Canyon, Colorado Springs, 21 June 1912, *Churchill* (M 782190); dry woods, Indian Park, Brookvale, Clear Creek Co., 17 June 1918, *Churchill* (M 900312); Halfway-house, Pike's Peak, 1896, *F. Clements 182* (NY); openings and among aspen, s. w. of Long's Peak Inn, 12 Aug. 1907, *F. E. Clements* (NY); Minnehaha, 2600 m. alt., 1 July–5 Aug. 1901, *Clements & Clements 235* (G, M, MU, NY, R, US); Seven Lakes, 3500 m. alt., 4 July 1901, *Clements & Clements 298* (G, M, MU, NY, R, US); Garfield Range, 3700 m. alt., 20 June 1903, *Clements & Clements 431.1* (G, M, R, US); wooded hills, Nederlands, Boulder Co., 8550 ft. alt., 21 June 1919, *Clokey 3264* (F, G, M, NY, R, US); Estes Park, 11,500 ft. alt., 2 Aug. 1906, *Cooper 11* (R); Estes Park, 9000 ft. alt., 7 Aug. 1906, *Cooper 42* (R); Estes Park, 12,000 ft. alt., 13 Aug. 1906, *Cooper 116* (R); Estes Park, 9000 ft. alt., 15 July 1904, *Cooper 202* (R); Breckenridge, *Coulter* (M); White House Mts., 11,500 ft. alt., 9 Aug. 1873, *Coulter* (PA); Como and vicinity, 10,000 ft. alt.,

1 Aug. 1895, *Crandall* (NY); swamp above Beaver Creek, 9000–9500 ft. alt., 7 July 1896, *Crandall* (NY); mountains, Larimer Co., 7500 ft. alt., 10 July 1896, *Crandall* (MU 17312, NY); mountains of Larimer Co., 7000–8000 ft. alt., 14 July 1898, *Crandall* (R 13272); east slope, Rabbit Ear Range, 9800 ft. alt., 20 July 1894, *Crandall 6* (US); Williams Cañon, 7000 ft. alt., 27 May 1892, *Crandall 7* (US); above timber, Cameron Pass, 12,000 ft. alt., 1 Sept. 1890, *Crandall 11* (US); near Como, 10,000 ft. alt., 1 Aug. 1895, *Crandall 31* (US); eastern slope, Rabbit Ear Range, 9700 ft. alt., 20 July 1894, *Crandall 266* (G); Como and vicinity, 10,000 ft. alt., 1 Aug. 1895, *Crandall 1386* (R); above Beaver Creek, 9500–12,000 ft. alt., 7 July 1896, *Crandall 1388* (R, US, WSC); Como, South Park, 10,000 ft. alt., 1 Aug. 1895, *Crandall & Cowen* (M); Virginia Gulch, south slope of Needle Mountains, 11,500 ft. alt., 14 July 1901, *Cross 55* (US); near Ironton, San Juan Co., 21–31 July 1899, *Curtis* (NY); Cumbres, 18 July 1898, *F. S. Earle* (NY); Mancos, June 1891, *Eastwood* (NY); Durango, 7 June 1890, *Eastwood 8* (US); La Plata Mts., 23 July 1890, *Eastwood 11* (US); Keblar Pass, vicinity of Mount Carbon, Gunnison Co., 3100 m. alt., 24 June 1910, *Eggleston 5731* (US); vicinity of Mount Carbon, Gunnison Co., 2730 m. alt., 6 July 1910, *Eggleston 5859* (US); damp places, meadows, on Bard Creek, Empire, 5 Aug. 1874, *G. Engelmann* (M); springy places below Berthoud's Pass, 11,000 ft. alt., 10 Aug. 1874, *G. Engelmann* (M); Berthoud's Pass, 21 July 1881, *G. Engelmann* (M); Rocky Mountain Flora, Lat. 39°–41°, 1862, *Hall & Harbour 217* (G, M, PA, R); 1878, *Harmbach* (M); St. Elmo, 10,000 ft. alt., Aug. 1886, *E. T. Harper* (M 969952); Ruxton Park, Pike's Peak Trail, Aug. 1900, *Harper & Harper* (M 969822); mountain sides, Manitou, 16 July 1900, *Harper & Harper 2886* (M); near Leadville, 10,500 ft. alt., 9 June 1896, *Holzinger 1* (US); near Breckenridge, 10,000 ft. alt., 27–28 May 1896, *Holzinger 2* (US); along the cogg wheel railway to Pike's Peak, 7,000–10,000 ft. alt., 4–5 July 1896, *Holzinger 10* (US); La Veta Pass, 1877, *Hooker & Gray* (G); 1906, *E. L. Johnston 330* (R); in Horse Shoe Park, Estes Park, 10 Aug. 1910, *E. L. Johnston 751* (NY); Engelmann's Canyon, Colorado Springs, 31 May 1878, *M. E. Jones 140* (NY); sunny hillsides, Mineral Pt., 11,500

ft. alt., 13 July 1887, *Kempton* (M); Minnehaha, Pike's Peak, 8400 ft. alt., 14 June 1896, *Knowlton 3* (US); above Vallecito, 12,000 ft. alt., 4 Sept. 1903, *Knowlton 73* (US); Kenosho, 10,000 ft. alt., 8 Aug. 1886, *Letterman* (M 776550, 776555); Graymont, *Letterman 39* (M); Gray's Peak, 11,000 ft. alt., 23 July 1886, *Letterman 40* (M); near Breckenridge, Summit Co., 9600 ft. alt., Aug. 1901, *Mackenzie 7* (M, R); Aspenglen Camp, Fall River Road, near Estes Park, 21–22 June 1929, *Mathias 411, 446* (M); subalpine woods, Twin Sisters Mt., Estes Park, 23 June 1929, *Mathias 466* (M); Tolland, 9000 ft. alt., 4 July 1907, *Moyer* (MU 164831); Red Creek, 17 July 1908, *N. L. T. Nelson 166* (NY); Lake City, 1881, *Newberry* (NY); mts. of Larimer Co., June 1894, *Osterhout* (MU 164826); Leadville, last of June 1895, *Osterhout* (US 223482); Estes Park, Aug. 1895, *Osterhout* (MU 164816); mts. east of Estes Park, 19 July 1903, *Osterhout* (P 100176); mts. of Estes Park, Larimer Co., 19 July 1903, *Osterhout 2807* (G); moist woods, Tolland, 9000 ft. alt., 23 June 1913, *Overholts* (M 743706); in meadow, Tolland, 9000 ft. alt., 14 July 1914, *Overholts* (NY); in aspen woods, Tolland, 9000 ft. alt., 6 July 1923, *Overholts, Roberts & Shope 182* (M); rocky ground, mountain slopes, between Tolland and Corona, Gilpin Co., 24 June 1926, *E. J. Palmer 31274* (M); headwaters of Clear Creek, and the alpine ridges lying east of "Middle Park," 1861, *Parry 161* (G, NY); mountain sides near Georgetown, 8500 ft. alt., July 1885, *Patterson* (G); Clear Creek Canyon near Georgetown, 8500 ft. alt., 8, 27 July 1885, *Patterson 41* (CH, MU, NY, US); high mountains about Gray's Peak, near timber line, 10,000–12,000 ft. alt., 6 July, 10 Aug. 1885, *Patterson 42* (US); Lake City, 10 June 1878, *Pease* (NY); Silverton, Aug. 1885, *Popenoe* (CH 372263); Surface Creek, Mesa Gr., Delta Co., 8000 ft. alt., June 1892, *Purpus 157* (CH); mountains near Ironton, Red M., Uncompahgre River, 10,000–11,000 ft. alt., June 1893, *Purpus 461* (CH); mountains near Bear Creek, Uncompahgre River, 11,600 ft. alt., Aug. 1893, *Purpus 544* (CH); Blue Bird Mine, 1 July 1905, *Ramaley 1235* (R); Boulder Park, Tolland, 26 July 1913, *Ramaley 9668* (R); Tolland, 22 July 1909, *Ramaley & Robbins 6755* (R); near brooks, on flank of Snowy Range, 24 July 1872, *Redfield 2567* (M); West Indian Creek, 2500–2700 m.

alt., 14–15 June 1900, *Rydberg & Vreeland 5697* (NY); headwaters of Sangre de Christo Creek, 2700 m. alt., 22 June 1900, *Rydberg & Vreeland 5790* (NY); Pass Creek, 2400–2700 m. alt., 10 June 1900, *Rydberg & Vreeland 5791* (NY, US); Wahatoya Canyon, 2400 m. alt., 13 June 1900, *Rydberg & Vreeland 5792* (NY); on Turkey Creek and tributaries, 2800–2900 m. alt., 8–9 June 1900, *Rydberg & Vreeland 5793* (NY, US); East Indian Creek, 2400–2700 m. alt., 1 June 1900, *Rydberg & Vreeland 5794* (NY, R, US); mountain near Veta Pass, 3000 m. alt., 20 June 1900, *Rydberg & Vreeland 5795* (NY); West Indian Creek, 2500–2700 m. alt., 14–15 June 1900, *Rydberg & Vreeland 5796, 5798* (NY); West Indian Creek, 2500–2700 m. alt., 14–15 June 1900, *Rydberg & Vreeland 5797* (US); Veta Mountain, 2400–2700 m. alt., 4 June 1900, *Rydberg & Vreeland 5799* (NY, US); headwaters of Sangre de Christo Creek, 2700 m. alt., 22 June 1900, *Rydberg & Vreeland 5800* (NY); Wahatoya Canyon, 2400–2500 m. alt., 29 May 1900, *Rydberg & Vreeland 5801* (NY); Sangre de Christo Creek, 2400–2700 m. alt., 2 July 1900, *Rydberg & Vreeland 5802* (NY); open hillside and under shrubs, Pagosa Springs, 16 June 1924, *Schmoll 1095* (R); Chimney Rock Trail, Piedra, 21 June 1924, *Schmoll 1235* (R); Pike's Peak region, 1910, *Schneider 58* (R); Gulch, Mt. Harvard, 17 Aug. 1896, *Shear 3291* (NY); Veta Pass, 15 July 1896, *Shear 3652* (NY); Red Cliff, 22 July 1899, *Shear 4193* (US); mts., Georgetown, 19 Aug. 1895, *Shear 4502* (NY); Pike's Peak, 7 July 1896, *Shear 5202* (NY); mt. side, Red Cliff, 8610 ft. alt., 22 July 1898, *Shear & Bessey 4193* (NY); borders of woods in rich soil along Michigan River, North Park, 28 July 1884, *Sheldon 124* (US); Pagosa Springs, 7000 ft. alt., 4–19 June 1894, *B. H. Smith* (PA); Pagosa Springs, 20 May 1883, *B. H. Smith 44* (PA); Farnham, 10 July 1891, *E. C. Smith* (M); Pike's Peak, 1909, *Soth 7, 8* (R); Pike's Peak, 1909, *Soth 14, 15* (NY); common on slopes, Mount Carbon, 2700 m. alt., 12 June 1909, *Tidestrom 2231* (US); Ute Pass, 2 July 1886, *Trelease* (M); Leadville, 7 July 1886, *Trelease* (M); Telluride, 10,800 ft. alt., 25 Aug. 1894, *Tweedy 204* (US); La Plata Mts., 11,000 ft. alt., 15 July 1896, *Tweedy 488* (US); La Plata Mts., 11,500 ft. alt., 15 July 1896, *Tweedy 492* (US); Hahn's Peak, 9800 ft. alt., 4 July 1901, *Tweedy 4512* (NY, US);

mountains between Sunshine and Ward, Boulder Co., 8000–9500 ft. alt., Aug. 1902, *Tweedy 4989* (NY); Empire, Clear Creek Co., 8500 ft. alt., 15–25 July 1903, *Tweedy 5601* (NY, R); Ironton Park, 9 miles s. of Ouray, 2700 m. alt., 11 Sept. 1900, *Underwood & Selby 313* (NY); Ironton Park, 9 miles s. of Ouray, 2700 m. alt., 11 Sept. 1901, *Underwood & Selby 358* (NY); Rocky Mts., 1868, *Vasey* (M); Veta Pass, 1884, *Vasey* (US 44675); gravelly banks of Clear Creek, Rocky Mountains, 1868, *Vasey 226* (G, M); woods, Rocky Mountains, Lat. 40°–41°, 9000 ft. alt., 1868, *Vasey 226a* (G, M); Ute Pass Camp, base of Mt. Zirkel, Jackson Co., 9275 ft. alt., 14 July 1911, *Warren 25* (R); Mt. Emmons, Gunnison Co., 11,500 ft. alt., 24 June 1902, *Warren 1084* (US); near Verde, June 1892, *Wetherill* (CH 376378); Sapinero, 1898, *Wheeler 506, 537* (R); Pike's Peak, 10 July 1901, *C. S. Williamson* (PA); Breckenridge, 1887, *Wislizenus* (M); Half-Moon Creek, Aug. 1873, *Wolf 716* (US); Clear Creek Cañon, 1873, *Wolf 716–18* (NY); Union Creek Gap, 12,000 ft. alt., July–Aug. 1873, *Wolf 719* (F, US); Lake Creek, July 1873, *Wolf 720* (*667*) (US); Clear Creek, June 1873, *Wolf 724* (*127*) (US); Clear Creek Cañon, June 1873, *Wolf 724* (F); Twin Lakes & Union Pass, 1873, *Wolf & Rothrock 719, 720* (G); Clear Creek, 1873, *Wolf & Rothrock 724* (G).

New Mexico: Canyon E, vicinity of Santa Fe, 2400 m. alt., 20 July 1926, *Arsène & Benedict 15707* (US); Pecos Baldy, 11,000 ft. alt., 30 July 1903, *Bailey 574* (US); Jemez Mts., 11,000 ft. alt., 4 Sept. 1906, *Bailey 1035* (US); in forest of Douglas spruce and rock pine, Cox Canyon, Alamo National Forest, 11 Aug. 1911, *Barlow* (F 409768, 409777, 409778, 409782, 409783, M); on cutover land, head of Rio Fresnal, 12 Aug. 1911, *Barlow* (F 409781); Sandia Mts., Oct. 1853–4, *Bigelow* (G, US 44723); Copper Mines, *Bigelow 419* (NY); n. slope, granite soil, Burro Mts., 7000 ft. alt., 4 Aug. 1906, *Blumer 1822* (F, G, NY, US); top of Las Vegas Range, 11,000 ft. alt., *T. D. A. Cockerell* (NY, R); Beulah, 8000 ft. alt., 1900, *T. D. A. Cockerell* (US 404915); top of range between Sapello & Pecos rivers, 11,000 ft. alt., 1–4 Aug. 1900, *Cockerell & Cockerell* (NY); Pecos River, Truchas Peak [T. R. N. M.], 15 June 1898, *Coghill 3* (M); Little Baldy Peak, Magdalena Mts., 24 Aug. 1903, *Diehl 384* (P); top of

Hillsboro Peak, Mimbres Mts., 31 Aug. 1903, *Diehl 425* (P); Cook's Cabin, Hop Canyon, Magdalena Mts., 24 Aug. 1903, *Diehl 507* (P); El Capitan Mts., Lincoln Co., 8000 ft. alt., 28 July 1900, *Earle & Earle* (NY); hills southwest of Tierra Amarilla, Rio Arriba Co., 2300 m. alt., 18 April–25 May 1911, *Eggleston 6500* (US); between Mogollon Ranger Station and Willow Creek (Silver-Willow Creek divide), Gila Forest, Socorro Co., 2100–2900 m. alt., 29 July 1920, *Eggleston 16831* (NY); Diamond Bar Range, Gila Forest, Socorro Co., 1800–2100 m. alt., 7 Aug. 1920, *Eggleston 16968* (NY); in copses, Balsam Park, Sandia Mountains, 8200 ft. alt., 8 May 1914, *Ellis 55* (NY, US); open places in oak brush, Balsam Park, Sandia Mountains, 8 May 1914, *Ellis 55* (US); Balsam Park, Sandia Mountains, 8 May 1914, *Ellis 55a* (US); "along Santa Fe Creek," 1847, *Fendler 276* (G TYPE, M, NY, PA, US); Pinos Altos Mountains, 22 June, 27 July 1880, *Greene 142* (G); Santa Fe Cañon, 9 miles east of Santa Fe, 8000 ft. alt., 2 June 1897, *Heller & Heller* (NY); Santa Fe Cañon, 9 miles east of Santa Fe, 8000 ft. alt., 2 June 1897, *Heller & Heller 3651* (M, MU, US); Hanover Mt., 29 July 1911, *Holzinger* (US 660491); Hanover Mt., 27 Aug., 12 Sept. 1911, *Holzinger* (MU 164814); lower valley of the Tulerosa River, Socorro Co., 30 Aug. 1905, *W. Hough* (US 497733); Carlsbad, 4 June 1924, *Lee 154* (US); Cimarron Canyon, south of Cimarron, 30 June 1929, *Mathias 569, 569a* (M); summit of Taos Pass, 30 June 1929, *Mathias 574* (M); Big Hatchet Mts., 17 May 1892, *Mearns 39* (US); Burro Mts., Grant Co., 8000 ft. alt., 20 June 1903, *Metcalfe 180* (G, M, MU, N, NY, P, R, US); top of Mogollon Peak, Socorro Co., approx. 10,000 ft. alt., 15 Aug. 1903, *Metcalfe 520* (R); loose moist soil, Lookout Mines, Sierra Co., 8000 ft. alt., 7 July 1904, *Metcalfe 1180* (F); loose moist soil, Lookout Mines, south end of Black Range, Sierra Co., 8800 ft. alt., 22 July 1904, *Metcalfe 1180* (G, NY, US); Pinos Altos, 7 Aug. 1895, *Mulford 739* (M, NY); Hanover, 9 Aug. 1895, *Mulford 790* (M); Santa Rita, 9 Aug. 1895, *Mulford 816* (M, NY); Pinos Altos, June 1891, *Neally 46* (F, M, NY, US); Silver Canyon, around Mitchell Gray's Cabin, Black Range, west flank of Sawyer's Peak, Grant Co., 7300 ft. alt., 20 Aug. 1915, *Pilsbry* (PA 574166); Mogollon Mts., Sept. 1881, *H. H.*

Rusby (NY); deep cañons, Bear Mts., May 1881, *H. H. Rusby 147½* (M, NY, US); shady cañons, Bear Mts., June 1881, *H. H. Rusby 147½* (G); shaded canyons, Mogollon Mts., Aug. 1881, *H. H. Rusby 147¾* (M); dry hills, Mangus Springs, 25 Feb. 1880, *H. H. Rusby 148* (NY); Bear Mts., May 1881, *H. H. Rusby 148½* (M); shady cañons, Mogollon Mts., Aug. 1881, *H. H. Rusby 148½* (G, M, MU, US); Van Patten's, Organ Mts., 9 June 1906, *Standley* (M, US 560921); Filmore Cañon, Organ Mts., 23 Sept. 1906, *Standley* (M); Winsor's Ranch, Pecos River National Forest, 8400 ft. alt., 29 June 1908, *Standley 4027* (G, M, NY, US); Pecos Baldy, Pecos River National Forest, 12,000 ft. alt., 11 June 1908, *Standley 4319* (M, NY, US); Ponchuelo Creek, Pecos River National Forest, 8500 ft. alt., 30 July 1908, *Standley 4586* (G, M, NY, US); Truchas Peak, Pecos River National Forest, 12,500 ft. alt., 8 Aug. 1908, *Standley 4811* (US); canyons high up, on and near the Sierra Grande, Union Co., 2100–2925 m. alt., 19 June 1911, *Standley 6177* (US); moist thickets, vicinity of Chama, Rio Arriba Co., 2380–2850 m. alt., 9 July 1911, *Standley 6626* (US); meadows, Navajo Indian Reservation, in the Tunitcha Mountains, 8 Aug. 1911, *Standley 7546* (US); above timber line, Baldy Peak, Colfax Co., 3600 m. alt., 4 Sept. 1916, *Standley 14345* (US); aspen woods, vicinity of Brazos Canyon, Rio Arriba Co., 2 Sept. 1914, *Standley & Bollman 11058* (US); wet meadow, vicinity of Ensenada, Rio Arriba Co., 3 Sept. 1914, *Standley & Bollman 11111* (US); Cloudcroft, June 1912, *Stearns 350* (US); Las Vegas Hot Springs, San Miguel Co., May 1902, *Sturgis* (G); on side of high mesa, Coolidge, 19 June, *S. M. Tracy 201* (CH); mts. near Las Vegas, July 1881, *Vasey* (F 575157, NY); 1873, *Wolf & Rothrock 728* [Coll. *Loew*] (G); Organ Mountains, Dona Ana Co., *Wooton* (P 82143, R 58072); Rio Apache, 21 June 1892, *Wooton* (US 737593); Continental Divide, 2 Aug. 1892, *Wooton* (US 737584); Van Pattens, Organ Mountains, Dona Ana Co., 29 Aug. 1894, *Wooton* (US 737592); White Mountain Peak, 7500 ft. alt., 6 July 1895, *Wooton* (US 737583); Cloudcroft, Sacramento Mountains, 12 July 1899, *Wooton* (US 737588); Cloudcroft, Sacramento Mountains, 18 July 1899, *Wooton* (US 737585); Cloudcroft, Sacramento Mountains, Otero Co., 8 Aug. 1899, *Wooton* (M, P 82145,

R 58071, US 563892); near Holts Ranch, Mogollon Mountains, Socorro Co., 1900, *Wooton* (US 737142); N Bar Ranch, 3 Aug. 1900, *Wooton* (US 737594); White Mountain Peak, 1 Aug. 1901, *Wooton* (US 737587); Van Pattens, Organ Mountains, Dona Ana Co., 16 July 1902, *Wooton* (US 737595); Sycamore Creek, 13 Aug. 1902, *Wooton* (US 737590); Burro Mts., 18 Aug. 1902, *Wooton* (US 737591); Filmore Canyon, Organ Mountains, Dona Ana Co., 26 May 1905, *Wooton* (US 737596); Sandia Mountains, Sandoval Co., 4 Aug. 1910, *Wooton* (US 737589); White Mountains, Lincoln Co., 7500 ft. alt., 15 Aug. 1897, *Wooton 350* (G, M, MU, NY, P, R, US); mts. west of Grant's Station, 1 Aug. 1892, *Wooton 416* (US); Organ Mts., 6500 ft. alt., 23 Sept. 1906, *Wooton & Standley* (NY, US 564197); White Mountains, Lincoln Co., 7400 ft. alt., 25 Aug. 1907, *Wooton & Standley* (US 562117); Coppermine Creek, 1851, *Wright 1107* (G, NY, PA, US).

UTAH: Wasatch Mountains, 1908, *Clos 56* (US); among the rocks, La Sal Mountains, San Juan Co., 8500 ft. alt., 14 June 1927, *Cottam 2227* (BYU); among oaks in dry situation, Arch Canyon, San Juan Co., 8000 ft. alt., 26 June 1927, *Cottam 2425* (BYU); alpine meadows, Cedar Breaks, Iron Co., 10,000 ft. alt., 11 June 1929, *Cottam 4245* (BYU); stream bed, La Sal, San Juan Co., 8500 ft. alt., 16 June 1927, *Cottam & Hutchings 2295* (BYU); Gold Mountain, 22 Aug. 1901, *M. E. Jones* (D 149834, P 82140); Marysvale, 31 May 1894, *M. E. Jones 5367* (NY); Marysvale, 8900 ft. alt., 2 June 1894, *M. E. Jones 5367* (M, US); Mt. Ellen, Henry Mts., 11,000 ft. alt., 25 July 1894, *M. E. Jones 5679* (US); Mt. Ellen, Henry Mts., 11,000 ft. alt., 25 July 1894, *M. E. Jones 5680* (M); Bromide Pass, 10,000 ft. alt., 27 July 1894, *M. E. Jones 5695t* (US); Fish Lake, 10,000 ft. alt., 2 Aug. 1894, *M. E. Jones 5717k* (US); Fish Lake, 10,000 ft. alt., 7 Aug. 1894, *M. E. Jones 5770h* (US); Marysvale, 11,500 ft. alt., 23 Aug. 1894, *M. E. Jones 5893u* (US); Panguitch Lake, 8400 ft. alt., 7 Sept. 1894, *M. E. Jones 6015x* (US); alpine meadows, Cedar Breaks, near Cedar City, 19 July 1929, *Mathias 713* (M); grassy slopes, La Sal Mts., Grand Co., 10,500 ft. alt., 31 July 1924, *Payson & Payson 4091* (G, M, R); sodded places, La Sal Mts., Grand Co., 11,500 ft. alt., 1 Aug. 1924, *Payson & Payson 4109* (R); mountains north of Bullion Creek, near Marysvale, 23

July 1905, *Rydberg & Carlton 7089* (G, NY, R, US); mountains north of Bullion Creek, near Marysvale, 23 July 1905, *Rydberg & Carlton 7114, 7164, 7166* (NY); mountains north of Bullion Creek, near Marysvale, 23 July 1905, *Rydberg & Carlton 7127* (US); mountains north of Bullion Creek, near Marysvale, 23 July 1905, *Rydberg & Carlton 7167* (NY, US); Mount Barette, 26 July 1905, *Rydberg & Carlton 7254* (NY); divide between Sevier and Beaver Rivers, near Belcnap Peak, 28 July 1905, *Rydberg & Carlton 7340* (NY); Aquarius Plateau, at the head of Poison Creek, 4 Aug. 1905, *Rydberg & Carlton 7389* (G, NY, R, US); Aquarius Plateau, at the head of Poison Creek, 4 Aug. 1905, *Rydberg & Carlton 7426* (NY, US); Aquarius Plateau, at the head of Poison Creek, 4 Aug. 1905, *Rydberg & Carlton 7437* (G, NY); Aquarius Plateau, at the head of Poison Creek, 4 Aug. 1905, *Rydberg & Carlton 7439, 7440* (NY); Fish Lake Plateau, 9 Aug. 1905, *Rydberg & Carlton 7671* (NY); western slope of La Sal Mountains, 2200–3000 m. alt., 6 July 1911, *Rydberg & Garrett 8632* (MU, NY); La Sal Mountains, 3300–3600 m. alt., 7 July 1911, *Rydberg & Garrett 8696* (NY, US); La Sal Mountains, 3000–3300 m. alt., 7 July 1911, *Rydberg & Garrett 8708* (M, NY); West Mt. Peal, La Sal Mountains, 3300 m. alt., 10 July 1911, *Rydberg & Garrett 8788, 8789* (NY); Gold Basin, La Sal Mountains, 3000–3300 m. alt., 11 July 1911, *Rydberg & Garrett 8833* (NY); along Brumley Creek, La Sal Mountains, 2700–3000 m. alt., 12 July 1911, *Rydberg & Garrett 8892* (NY, R, US); ridge north of Brumley Creek, La Sal Mountains, 2700–3000 m. alt., 14 July 1911, *Rydberg & Garrett 8927* (NY); ridge north of Brumley Creek, La Sal Mountains, 2700–3000 m. alt., 14 July 1911, *Rydberg & Garrett 8928* (NY, R, US); Gold Basin, La Sal Mountains, 3000 m. alt., 19 July 1911, *Rydberg & Garrett 9070* (G, MU, NY); south side of Abajo Mountains, 2000–2500 m. alt., 28–29 July 1911, *Rydberg & Garrett 9234* (NY); Elk Mountains, near Scorup's Camp, 2500 m. alt., 8 Aug. 1911, *Rydberg & Garrett 9536* (NY); Abajo Mountains (eastern range), 3000–3300 m. alt., 17 Aug. 1911, *Rydberg & Garrett 9715* (US); Abajo Mountains, near Spring Creek, 2700–3000 m. alt., 17–20 Aug. 1911, *Rydberg & Garrett 9715* (NY); abundant in rocky places on plateau, east of Ephraim Cañon, Wasatch Mountains, 2900 m. alt., 14 Aug.

1907, *Tidestrom 206* (US); abundant on summit east of Ephraim Cañon, Wasatch Mountains, 3000 m. alt., 15 Aug. 1907, *Tidestrom 249* (US); very abundant on Little Horse Shoe Summit, Wasatch Mountains, 3000 m. alt., 28 Aug. 1907, *Tidestrom 367* (US); common on slopes of Mt. Terrell, Wasatch Mountains, 3075 m. alt., 27 Aug. 1908, *Tidestrom 1811* (US); abundant in places, Wasatch Plateau, east of Ephraim, 3000 m. alt., 14 July 1909, *Tidestrom 2454* (US); abundant on rocky summits, near Tusher Ranger Station, Fillmore N. F., 3 Sept. 1909, *Tidestrom 2915* (US); marsh flat, under pines, Pine Flats, La Sal Mts., San Juan Co., 11 July 1912, *Walker 242* (G, MU, R); Fish Lake Mountain, 11,500 ft. alt., 8 July 1875, *Ward 330* (G, M, US); Fish Lake Mountain and slope of Aquarius Plateau, 9000–11,578 ft. alt., 8 July, 2 Aug. 1875, *Ward 330, 494* (US); 1875, *Ward 31453* (*330*) (G).

Arizona: Thomas Peak, White Mountains, 12 Sept. 1908, *Bailey 1437* (US); Williams, 1–15 June 1901, *H. S. Barber 73* (US); rolling andesitic, pine land, recently lumbered, Barfoot Park, Chiricahua Mountains, 8000–8250 ft. alt., 12 Sept. 1906, *Blumer 1365* (G, M, MU, NY, US); stony ground, Barfoot Park, Chiricahua Mountains, 8000 ft. alt., 12 Sept. 1906, *Blumer 1365* (F, G); rolling, andesitic, pine land, recently lumbered, Barfoot Park, Chiricahua Mts., 8000–8250 ft. alt., 12 Sept. 1906, *Blumer 1366* (F, G, M, MU, NY, US); rocky soil, Spud Ranch, Rincon Mts., 7400 ft. alt., 31 Aug. 1909, *Blumer 3315* (F, G, M); Rustlers Park, Bar-foot fire station, Chiricahua National Forest, Cochise Co., 2480–2670 m. alt., 22–23 Sept. 1914, *Eggleston 10755* (US); Bar-foot fire station, Chiricahua National Forest, Cochise Co., 2480 m. alt., 22–23 Sept. 1914, *Eggleston 10827* (US); Bar-foot fire station to Paradise, Chiricahua National Forest, Cochise Co., 2400 m. alt., 23 Sept. 1914, *Eggleston 10855* (US); Riverside Ranger Station, Greer, Apache Forest, Apache Co., 2700 m. alt., 20 Aug. 1902, *Eggleston 17063* (US); Tucson, 8000 ft. alt., 13 July 1922, *Fisher 225* (R); open ridges, upper Miller Cañon, Huachuca Mts., 18 Aug. 1909, *Goodding 421* (G, NY, R); aspen groves, Little Colorado River, White Mts., 19 July 1910, *Goodding 639* (G, NY, R, US); open brush land, Natanes Plateau, 26 June 1912, *Goodding 1039* (NY, R, US); Williams, 8–25 July

1903, *Griffiths 4930* (M, US); St. John's to White Mts., 6–15 Aug. 1903, *Griffiths 5219* (US); White Mts., 6–15 Aug. 1903, *Griffiths 5328* (US); near Flagstaff, 1923, *H. C. Hanson* (R 99557); rocky hillside, near Flagstaff, 7000 ft. alt., 23 Aug. 1922, *H. C. Hanson A215* (M); slopes, Shulz Pass near Flagstaff, 8000 ft. alt., 28 July 1922, *H. C. Hanson A216* (M, NY); open pines, Flagstaff, 7000 ft. alt., 17 Aug. 1922, *H. C. Hanson A217* (F, M, NY); San Francisco Mts., near Flagstaff, 30 June 1923, *Hanson & Hanson A606* (M, R); San Francisco Mts., near Flagstaff, 8000–11,300 ft. alt., 11 Aug. 1923, *Hanson & Hanson A782* (M, R); San Francisco Mts., 9000–11,300 ft. alt., 11 Aug. 1923, *Hanson & Hanson A783* (M); Ryan Ranch, Apache Res., 3 Oct. 1927, *Harrison 4878* (US); Hilltop, Apache Res., 8 June 1928, *Harrison 5455* (US); Lakeside, White Mts., 9 June 1928, *Harrison 5503* (US); Huachuca Mts., 8 Aug. 1893, *Holzner 1738* (US); head of Blue River, Graham Co. (seven miles southeast of Luna, New Mexico), Aug. 1905, *W. Hough* (US 497693); Forestdale, Apache Reservation, 66 miles south of Holbrook, 5 July 1901, *W. Hough 99* (US); Linden, White Mountains, 20 June 1901, *W. Hough 100* (US); Flagstaff, 4 Aug. 1884, *M. E. Jones* (NY); Flagstaff, 13 Aug. 1884, *M. E. Jones* (US 44665); Oracle, 6500 ft. alt., 28 Aug. 1903, *M. E. Jones* (P 82138, 82148); Flagstaff, 7 Aug. 1884, *M. E. Jones 4016* (NY, R, US); Greenland Point, 8000 ft. alt., 19 Sept. 1894, *M. E. Jones 6056g* (US); San Francisco Mts., 23 Aug. 1889, *Knowlton 74* (CH, US); San Francisco Mts., 11,000 ft. alt., 23 Aug. 1889, *Knowlton 81* (CH, N, US); San Francisco Mts., 26 Aug. 1889, *Knowlton 120* (CH, N, US); Prescott, 25 June 1896, *Kunze* (US 664145); Prescott, 5 July 1896, *Kunze* (US 348988); summit of Mt. Humphrey, 12,860 ft. alt., 28 July 1897, *Kunze* (NY); Mt. Humphrey, 8600 ft. alt., 30 July 1897, *Kunze* (NY); western slopes of San Francisco Peaks, 2000 m. alt., 3 July 1901, *Leiberg 5617* (US); western slope of San Francisco Peaks, 2300 m. alt., 3 July 1901, *Leiberg 5630* (US); slopes along upper Smith Creek, San Francisco Peaks, 3000 m. alt., 27 July 1901, *Leiberg 5761* (US); damp soil in the bottoms of Walnut Canyon, San Francisco Mts., 1500 m. alt., 1 Aug. 1901, *Leiberg 5786* (US); Flagstaff, Sept. 1884, *J. G. Lemmon* (US 44681, 44682); peak east of Rucker Valley, 1881,

J. G. Lemmon 392 (G); Huachuca Mts., 1881, *J. G. Lemmon 392* (US); Tanner's Cañon, near Fort Huachuca, July 1882, *J. G. Lemmon 2712* (G); De la Vergne Park, and Flagstaff, Sept. 1884, *Lemmon & Lemmon* (US 44680); about Mormon Lake, 6000 ft. alt., 12 June 1898, *MacDougal 106* (F, G, NY, US); vicinity of Flagstaff, 7000 ft. alt., 8 July 1898, *MacDougal 256* (F, G, NY, PA, R, US); about Walnut Canyon, 7000 ft. alt., 23 July 1898, *MacDougal 332* (F, G, NY, US); Humphrey's Peak of San Francisco Mountains, 9000–12,000 ft. alt., 7–10 Aug. 1898, *MacDougal 395* (NY, PA, R, US); submontane woods, Kaibab Plateau, north of Jacob's Lake, 14 July 1929, *Mathias 661, 663* (M); above timber line, San Francisco Mts., 12,000–13,000 ft. alt., 4 June 1887, *Mearns 35* (NY); Mogollon Mts., 12,000 ft. alt., 4 June 1887, *Mearns 103* (CH, NY); Johnston's Ranch, near monument No. 88, Mexican Boundary line (Cochise Co.), 12 Aug. 1893, *Mearns 1793* (US); Grand Cañon, *Millspaugh 105* (F); 4 July 1869, *E. Palmer* (US 44672, 44673); Willow Spring, 10–20 June 1890, *E. Palmer 500* (G, US); Sta. Catalina Mts., 7500 ft. alt., 28 July 1926, *Peebles, Harrison & Kearney 2512* (M, US); Mt. Graham, 23 July 1927, *Peebles, Harrison & Kearney 4484* (US); near Flagstaff, 21 Aug. 1926, *Porter & Fulton 2840* (US); Huachuca Mts., 7 July 1884 *Pringle* (CH, G, M, MU, NY, PA); San Francisco Mountains, May–Oct. 1900, *Purpus 8070* (CAL); 9000 ft. alt., Sept. 1874, *Rothrock* (MU 164829); Willow Spring, July 1874, *Rothrock 253* (US); Mt. Graham, 9000 ft. alt., Aug.–Sept. 1874, *Rothrock 738* (G); Bill Williams Mt., 30 Aug. 1909, *H. H. Rusby* (NY); Flagstaff, Aug. 1883, *H. H. Rusby 631* (G, NY, US); Mt. Humphreys, July 1883, *H. H. Rusby 632* (F, NY, US); near Cole's Camp, Santa Catalina Mts., 7000 ft. alt., 26 Aug. 1908, *Shreve* (F); Harts little spring, 13 July 1892, *Toumey 190* (NY); San Francisco Mts., 1892, *Toumey 190* (US); Cheno Valley, 24 June 1892, *Toumey 192* (US); sandy soil in valley, Flagstaff, 24 June 1887, *S. M. Tracy 235* (CH, NY); dry sandy soil in valley, Flagstaff, 26 June 1887, *S. M. Tracy 236* (CH, US); at lower edge of lava bed, Flagstaff, 26 June, *S. M. Tracy 258* (CH); cool canyon heads, Navaho Reservation, 23 July 1916, *Vorhies 110* (G, M, NY); Flagstaff, 6 June 1901, *Ward* (NY, US 410235, 410236); Colorado Plateau, Grand Cañon, 11 June

1901, *Ward* (US 410234); near Fort Huachuca, Sept. 1894, *T. E. Wilcox 481* (US); 1873, *Wolf & Rothrock 729* [Coll. *Loew*] (G); Grand Canyon, 7 July 1892, *Wooton* (US 737582); Turkey Tank, 18 July 1892, *Wooton* (US 737549); Flagstaff, 3 July 1892, *Wooton 420* (US); Pinedale, 20 July 1897, *Zuck* (US 664407).

Chihuahua: mesa, west of Soldier Canyon, Sierra Madre Mts., 7000 ft. alt., 16 Sept. 1903, *M. E. Jones* (P 82153); Meadow Valley, Sierra Madre Mts., 7000 ft. alt., 17 Sept. 1903, *M. E. Jones* (M, P 82158); Round Valley, Sierra Madre Mts., 7000 ft. alt., 17 Sept. 1903, *M. E. Jones* (P 82155); Mound Valley, Sierra Madre Mts., 7000 ft. alt., 18 Sept. 1903, *M. E. Jones* (NY, P 82156, 82157); vicinity of Madera, about 2250 m. alt., 27 May–3 June 1908, *E. Palmer 276* (M, NY, US); cool slopes, foothills of the Sierra Madre, 19 Sept. 1887, *Pringle 1250* (G, M, MU, NY, PA, US); near Colonia Garcia in Sierra Madres, 7500 ft. alt., 9 June 1899, *Townsend & Barber 29* (G, M, N, NY, P, R, US); 5 mi. s. e. of Colonia Garcia, Sierra Madre, 7500 ft. alt., 13 June 1899, *Townsend & Barber 29* (US).

Sonora: San Jose Mts., 3 Aug. 1893, *Mearns 1612* (US); at summit, San Jose Mts., 3 Aug. 1893, *Mearns 1613* (G, NY, US).

Durango: Otinapa, 25 July–5 Aug. 1906, *E. Palmer 439* (M, NY, US).

This species may be considered as one of the most "polymorphic" of the group. The variability is exceedingly perplexing and has resulted in much misinterpretation, which began with Dr. Gray's description of the type, *Fendler no. 276*, from "Sunny declivities, at the foot of mountains, along Santa Fe Creek," New Mexico. In connection with the original description Dr. Gray states: "There are two forms in the collection; one, probably the vernal state, is only a span high, with the leaves cut into linear or lanceolate divisions; the other, probably gathered in July, is a foot or two in height and with coarser foliage. There is apparently no other distinction."[62] In connection with this study the author has had the opportunity of examining much of the material distributed under Fendler's no. 276. The type sheet, now in the Gray Herbarium of Harvard University (pl. 32, fig. 1), contains both forms as mentioned by Dr. Gray, but the

[62] Gray, Mem. Am. Acad. N. S. 4: 57. 1849 [Pl. Fendl.].

plant he describes as the taller and probably summer form must be considered as the actual type since preference is given to it in the original description. This plant is tall, slender, caulescent, about 4.5 dm. high, with bi–tri-pinnatisect leaves with broad ultimate segments, and must be considered as "typical" for the species. The other plant, "the vernal state," represents an extreme condition which at first glance would appear specifically distinct. However, if one considers the cotype specimens of *Fendler no. 276* in the herbaria of the Missouri Botanical Garden, New York Botanical Garden, and the United States National Museum the situation is even more complicated. The sheet in the Missouri Botanical Garden Herbarium contains two forms distinct from either of those described by Dr. Gray. In all, four different forms are represented under *Fendler no. 276*, a "tenuifolius" type, a "eu-montanus" type, a "multifidus" type, and certain intermediates.

The type of *Thaspium montanum* var. *tenuifolium* Gray, *Wright no. 1107*, from "Hill-sides of Coppermine Creek, New Mexico," introduces an extreme leaf variation, filiform ultimate segments sometimes much elongated. It differs in no other essential from the Fendler type, excluding the "tenuifolius" forms distributed under the Fendler number. This variety has been raised to specific rank by Rydberg;[63] and Wooton and Standley state concerning its status: "Apparently this is a very good species, distinguished from *P. montanus* by its tufted habit, much elongated, very narrow leaf segments, and pale flowers. It is found in different situations, too, preferring crevices of cliffs in the deep canyons, always growing in shade."[64] A large series of specimens shows the two forms to be identical in habit and the character of the tufted growth occurs throughout the group, the type specimen of *P. montanus* even showing this condition. The author has collected the two forms growing in the same locality, intermixed, and showing every variation in the colony from the broad-leaf type to the filiform divisions. The factor of flower color is an extremely variable one in the group and can not be considered of any specific value.

[63] Rydberg, Bull. Torr. Bot. Club 33: 147. 1906.

[64] Wooton and Standley, Contr. U. S. Nat. Herb. 19: 483. 1915 [Fl. New Mex.].

Peucedanum Lemmonii Coulter and Rose is a form of the "tenuifolius" type common in Chihuahua and southern Arizona, showing an abortion of dorsal wings comparable to the "sylvaticus" variation.

The variety *purpureus* was distinguished by Coulter and Rose[65] as having a "weakly ascending peduncle," a shortly caulescent habit, and purple flowers. This variety has also been raised to specific rank by Rydberg.[66] Wooton and Standley retain this type as worthy of specific recognition, remarking: "This form seems to us distinct enough to rank as a species. It certainly is much more easily recognized than most of the species of the family. We have never seen it occurring with the other species nor have we ever seen intergradient forms."[67] However, a critical study of a large series of specimens has shown the purple-flowered character to be an extremely variable one, certain plants showing both yellow flowers and purple flowers from the same root. The habital character is also of little value since purple flowers occur in every habital type in the group.

The next species described was *P. sylvaticus* Nels. Following the description of the species, Nelson comments concerning it: "Allied to *P. montanus* (Gray) C. & R. In fact the descriptions as drawn do not readily separate them. A considerable series of *P. montanus*, however, show the two species to be wholly distinct. The Wyoming plants when fully mature are seen to be tall slender plants, with the leaf-segments parted into long linear lobes. The peduncles are long and naked, the fruits are broader with thinner, conspicuous wings and the oil tubes are on the whole fewer. Their habitats seem to be as wholly different as their aspect. The typical New Mexican *P. montanus* occurs on 'Sunny declivities at the foot of mountains,' while *P. sylvaticus* is found in dense, wet or even boggy woods along streams."[68] It will be remembered that the actual type specimen of *P. montanus* is a tall slender plant, of approximately the same height as the plants distributed under Nelson's type number

[65] Coulter and Rose, Rev. N. Am. Umbell. 75. 1888.
[66] Rydberg, Bull. Torr. Bot. Club 33: 147. 1906.
[67] Wooton and Standley, Contr. U. S. Nat. Herb. 19: 483. 1915 [Fl. New Mex.].
[68] Nelson, Bull. Torr. Bot. Club 28: 224. 1901.

7667. The division of the leaves and the contour of the ultimate segments intergrade. The oil-tube number of true *montanus* may be reduced to one in the interval. Habitally *Fendler no. 276* and *Nelson no. 7667* are similar. The only difference is in the occasional abortion of the dorsal wings of the fruit manifest in the Nelson specimen, a character of little value. The habitats are more similar than the above quotation would indicate, since the type locality for the Fendler plant is in Santa Fe Canyon, along Santa Fe Creek, a situation quite comparable and parallel to that existing in the type locality of *P. sylvaticus*, "wooded, wet bottom lands, Tie City, Albany Co., Wyoming" (pl. 32, fig. 1; pl. 33, fig. 1).

Rydberg in 1904 described the variety *multifidus*, basing it on a collection of Cockerell from the "range between Sapello and Pecos rivers," New Mexico. In 1906 he raised the variety to specific rank. A large series of specimens shows this to be nothing more than a variation of *montanus*, with an intergradation of all characters.

In 1909 Coulter and Rose described *P. Tidestromii*, basing it on *Tidestrom no. 1811* collected "on slopes of Mount Terrell, Wasatch Mountains," Utah, at an altitude of 3075 meters. The brief discussion following the description states that it is "nearest *P. multifidus* Rydb., but mostly acaulescent and with different leaf dissection."[69] The type sheet contains both caulescent and acaulescent forms and a series of specimens shows this species to be only a geographical variation of true *montanus* with such intergradation that it seems inadvisable to consider it worthy of even varietal rank.

Pseudocymopterus versicolor Rydb. was distinguished by its flowers being purple, or orange tinged with purple, the shorter involucel bracts, and the narrowly linear leaf segments. Again a study of numerous specimens shows these characters to be so variable that they can be of no value in the segregation of species.

The author has had the opportunity of making field surveys and studying several hundred herbarium specimens in the *montanus* group. As a result it has been concluded that the characters upon which the several species had been based were

[69] Coulter and Rose, Contr. U. S. Nat. Herb. 12: 447. 1909.

natural variations in a "polymorphic" species, and by the recognition of only one species its delimitations become more natural and distinct. The variations which occur are noticeable primarily in such vegetative characters as leaf division, shape and size of the ultimate segment, and height of growth. These characters are widely variable, governed to a great extent by the habitat of the individual plant, and show all intergradations from one extreme to the other. The flower color-character, another easily recognizable one, sometimes varies on the same plant from yellow, through orange-purple, to purple, and is consequently of no value for even varietal or formal designation. The essential characters of the fruit, however, are fairly constant throughout the group, as are the other characters found of value in specific delimitation in other groups.

Such a treatment of a "polymorphic" group is the natural result of continued investigation, field studies, and additional collections. It becomes possible only through such studies to determine the status of apparent variations, the concomitant occurrence of variation, and its correlation with habitat factors.

2. P. Davidsoni (Coult. & Rose) Mathias, new comb.

Pl. 25, fig. 14; pl. 34, fig. 1.

Aletes (?) Davidsoni Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 107. 1900.

Pseudocymopterus filicinus Wooton & Standl. Contr. U. S. Nat. Herb. **16**: 158. 1913; Contr. U. S. Nat. Herb. **19**: 483. 1915 [Fl. New Mex.].

Plants caulescent, 1.5–3.5 dm. high, from a long, more or less slender tap-root; leaves oblong to ovate-oblong in general outline, excluding the petiole, 1.5–14 cm. long, 1–9 cm. broad, mostly tripinnatisect, sometimes scaberulent at the nodes, ultimate segments mostly linear, acute, mucronate, slightly confluent, 1–30 mm. long, 1–3 mm. broad, petiole somewhat sheathing at the base, 1–7 cm. long; peduncles exceeding the leaves, axillary and terminal in the upper nodes, hirtellous at the base of the several-rayed umbel, rays spreading, more or less scaberulent, 5–30 mm. long, involucre usually absent, involucel bracts conspicuous, equalling or exceeding the yellow or purple flowers,

dimidiate, linear, acute, young fruit puberulent, mature fruit glabrous, oblong, 3–4 mm. long, 1–2 mm. broad, wings somewhat reduced, oil tubes 3–8 in the intervals, 3–8 on the commissure.

Type specimen: *Davidson 161a*, among rocks in moist creek, near Coronado Mine, Clifton, Arizona, 7 June 1900 (TYPE in the United States National Herbarium, cotypes in the herbaria of the New York Botanical Garden and the Missouri Botanical Garden).

Distribution: southeastern Arizona and adjacent New Mexico.

Specimens examined:

NEW MEXICO: Mangas, 1 Sept. 1897, *Metcalfe* (US 516894); Mangas Spgs., Aug. 1903, *Metcalfe* (MU 260110); Mangas Spgs., 17 June 1903, *Metcalfe 165* (US); Bear Mountain, near Silver City, Grant Co., 17 June 1903, *Metcalfe 165* (P, US); Bear Mt., near Silver City, Grant Co., 5000 ft. alt., 17 June 1903, *Metcalfe 169* (N).

ARIZONA: Garfield, 1 Sept 1903, *Davidson* (PA); Clifton, 1899, *Davidson 161a* (US); Clifton, 1900, *Davidson 161a* (M, NY); among rocks in moist creek, near Coronado Mine, Clifton, 7 June 1900, *Davidson 161a* (US TYPE, NY).

3. P. anisatus (Gray) Coult. & Rose, emend.

Pl. 25, figs. 15-16;pl. 35.

Cymopterus ? anisatus Gray, Proc. Acad. Phila. **1863:** 63. 1864, excl. *Parry no. 157;* Wats. Bot. King's Exp. 125. 1871, as to description in part; Port. & Coult. Syn. Fl. Col. 50. 1874, in part; Wats. Bibl. Ind. **1:** 418. 1878, in part; Coult. Man. Bot. Rocky Mt. 119. 1885, in part.

Pseudocymopterus anisatus (Gray) Coult. & Rose, Rev. N. Am. Umbell. 75. 1888, in part; Howell, Fl. N. W. Am. **1:** 258. 1898, in part; Coult. & Rose, Contr. U. S. Nat. Herb. **7:** 189. 1900, in part; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909, in part; Nels. Spring Fl. Intermt. States, 118. 1912, in part.

P. aletifolius Rydb. Bull. Torr. Bot. Club **31:** 574. 1904; Fl. Col. 257. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909.

Pseudopteryxia anisata (Gray) Rydb. Bull. Torr. Bot. Club **40:** 71. 1913, in part.

P. aletifolia Rydb. Bull. Torr. Bot. Club **40**: 72. 1913; Fl. Rocky Mts. 624. 1917, and ed. 2. 624. 1922.

Plants acaulescent from a long thickened tap-root crowned with persistent leaf bases, 1–3.5 dm. high, glabrous; leaves narrowly oblong in general outline, excluding the petiole, 3.5–14 cm. long, 1.5–3.5 cm. broad, bipinnatisect, ultimate segments rigid, acute, mostly confluent, appearing as lobes of a subcuneate leaflet, 1–6 mm. long, 1–1.5 mm. broad, petiole 3–11 cm. long; peduncles usually exceeding the leaves, umbels 6–9-rayed, rays of each umbel conspicuously unequal, 0.5–6 cm. long, involucre absent, involucel bracts conspicuous, much exceeding the yellow flowers, 0.3–1.5 cm. long, linear-lanceolate, entire; fruit narrowly oblong, 4–6 mm. long, 2–3 mm. broad, calyx teeth persistent, conspicuous, lateral wings present, linear or sublinear in cross-section, acute at the apex, dorsal wings abortive, appearing as minute projections on the dorsal surface, oil tubes 1–3 in the intervals, 2–4 on the commissure, strengthening cells absent or present.

Type specimen: *Hall & Harbour 222* "dry hills in the middle mountains," Rocky Mountains, Colorado, Lat. 39°–41°, 1862 (TYPE in the Gray Herbarium of Harvard University, cotypes in the herbaria of the Field Museum of Natural History, the Missouri Botanical Garden, the Academy of Natural Sciences, Philadelphia, and the United States National Museum).

Distribution: Colorado, in the region of El Paso County.

Specimens examined:

COLORADO: north of Cheyenne Cañon, neighborhood of Pike's Peak, 6 July 1895, *E. A. Bessey* (NY); Minnehaha, 8600 ft. alt., 31 July 1895, *E. A. Bessey* (NY); Greenhorn Mts., 1874, *T. S. Brandegee 954* (M); mts., Aug. 1871, *Canby* (G); dry ground, Bear Creek, Brookvale, Clear Creek Co., 13 June 1918, *Churchill* (G, M 900325); golf link, Manitou, 1900, *F. Clements* (NY); Ruxton, 1896, *F. Clements 211* (NY); Manitou, 19 Aug. 1900, *F. C. Clements* (US 370000); Minnehaha, 2600 m. alt., 16 June–22 July 1901, *Clements & Clements 94* (G, M, NY, US); Chiann Mt., July 1892, *Eastwood 6136* (NY); Pike's Peak, July, Aug. 1901, *Fossler* (M); Lake Ranch, *French* (G); on gravel slide, Engelmann Cañon, Pike's Peak, 8500 ft. alt., 8 July 1921, *H. M.*

Hall 11400 (US); Rocky Mt. Flora, Lat. 39°–41°, 1862, *Hall & Harbour 222* (G TYPE, F, M, PA, US); Cascade Cañon, Aug. 1900, *Harper & Harper* (M 969893); Ute Pass, Colorado Springs, 18 May 1878, *M. E. Jones 84* in part (NY); Ute Pass, Colorado Springs, 29 May 1878, *M. E. Jones 119* (NY); Peter's Dome, Petrified Stump, El Paso Co., 3 Aug. 1884, *Letterman 220* (M, US); slides, Pike's Peak, 14 Aug. 1913, *Macbride 2674* (M); near Golden City, Aug. 1871, *Meehan* (PA); South Cheyenne Canyon, Colorado Springs, 1800–2000 m. alt., 10 May 1900, *Rydberg & Vreeland 5815* (NY, US); Rocky Mts., 1869, *Scovell* (US 44727); below Half Way House, Pike's Peak, 3 July 1896, *Shear 3709* (NY, US); gravelly slopes, North Cheyenne Cañon, El Paso Co., 6 Aug. 1892, *Sheldon 105* (US); gravelly slopes, North Cheyenne Cañon, El Paso Co., 8500 ft. alt., 6 Aug. 1892, *Sheldon 428* (US); gravelly slopes, North Cheyenne Cañon, El Paso Co., 8500 ft. alt., 6 Aug. 1892, *Sheldon 5839* (NY).

In the enumeration of the Parry collection of 1861 in the Rocky Mountains Gray listed *Parry no. 157* as "*Cymopterus terebinthinus*, Torr. & Gray, var. *C. foeniculaceus* Nutt."[70] However, this was a case of mistaken identity which he corrected in 1864 in the list of the Hall and Harbour collections, when *no. 222* was described as a new species, *Cymopterus ? anisatus*, with the following comment: "called '*C. terebinthinus*, var. *foeniculaceus*' in Parry's 1861 collection (No. 157); but it can hardly be either of Nuttall's species under those names, on account of the very long and subulate leaflets of the involucel as well as calyx-teeth, yet apparently related to them; the foliage, &c., very similar. Mature fruit not collected; some of the present collection pretty well formed has the wings abortive, while in younger fruits of 1861 these are obvious and somewhat undulate."[71] Thus these two specimens, namely, *Hall and Harbour no. 222* and *Parry no. 157*, were the original material for *Cymopterus ? anisatus* Gray, with the former the type specimen because of priority of position.

This species, in 1888, was transferred to *Pseudocymopterus*

[70] Gray, Am. Jour. Sci. II, 33: 408. 1862.
[71] Gray, Proc. Acad. Phila. 1863: 63. 1864.

when Coulter and Rose[72] segregated that genus from the *Cymopterus* complex. In 1913 Rydberg[73] described the genus *Pseudopteryxia*, basing it on *Cymopterus ? anisatus* Gray.

In 1904 Rydberg[74] described *Pseudocymopterus aletifolius*, taking as the type *Clements no. 94* from Minnehaha, Colorado. In connection with the original description Rydberg comments: "This species is evidently most closely related to *P. anisatus*, but easily distinguished by the very unequal branches of the umbel, the longer, usually less winged fruit and especially by the leaves, which (although much firmer) resemble closely those of *Aletes acaulis*."[75]

An examination of the type material of *Cymopterus ? anisatus* Gray, namely *Hall and Harbour no. 222*, and *Pseudocymopterus aletifolius* Rydb., *Clements no. 94*, shows these two plants to be conspecific. However, *Parry no. 157* associated by Gray with the Hall and Harbour specimen in the original description of *Cymopterus ? anisatus*, as indicated above, is undoubtedly distinct and conspecific with *Pseudocymopterus anisatus* as generally interpreted by taxonomists and as treated in all the local manuals and studies in the family, excepting Coulter and Rose's 'Revision of the Umbelliferae.'[76] In this 'Revision' the Hall and Harbour specimen is the only collection cited and the specific description applies largely to it but figure 76 is the Parry type.

Consequently it becomes necessary to emend the previous treatments of the species *anisatus* to apply only to the "aletifolius" type, and *Pseudocymopterus anisatus*, as defined and delimited in this study, includes the Hall and Harbour collections distributed under *no. 222*, and the material referred by Rydberg to *P. aletifolius*. As a result the large bulk of material previously referred to *P. anisatus*, and conspecific with *Parry no. 157*, must be renamed. Since this study has shown *P. Hendersoni* Coulter and Rose[77] to be identical with the old *P. anisatus* it becomes the next available name and must therefore be applied to the species

[72] Coulter and Rose, Rev. N. Am. Umbell. 75. 1888.
[73] Rydberg, Bull. Torr. Bot. Club **40**: 71. 1913.
[74] Rydberg, Bull. Torr. Bot. Club **31**: 574. 1904.
[75] *Ibid.* 575. 1904.
[76] Coulter and Rose, Rev. N. Am. Umbell. 75. 1888.
[77] Coulter and Rose, Contr. U. S. Nat. Herb. **7**: 190. 1900.

P. anisatus as previously interpreted, *Pseudopteryxia longiloba*, a variant within the species, and *P. Hendersoni*.

Pseudocymopterus anisatus, as now defined (*P. aletifolius* Rydb.), is characterized by the aletoid foliage, the conspicuous unequally rayed umbels with the rays varying from one-half to six centimeters in length, and the abortion of the dorsal wings of the fruit (mentioned by Gray in the description of *Hall and Harbour no. 222*[78]). Contrasted with this, *P. Hendersoni* (the *P. anisatus* of authors and *Pseudopteryxia longiloba*) has bipinnatisect leaves with distinct linear segments, subequal umbel rays three to thirty millimeters long, and the usual presence of one to three dorsal wings similar to the lateral wings. The two species are readily distinguishable by these foliage and inflorescence characters.

4. P. Hendersoni Coult. & Rose, emend.

Pl. 25, figs. 17-18; pl. 35, fig. 1.

Cymopterus terebinthinus var. *foeniculaceus* Gray, Am. Jour. Sci. II, **33**: 408. 1862, as to *Parry no. 157*.

C. ? anisatus Gray, Proc. Acad. Phila. **1863**: 63. 1864, as to *Parry no. 157;* Wats. Bot. King's Exp. 125. 1871, as to *no. 453;* Port. & Coult. Syn. Fl. Col. 50. 1874, in part; Wats. Bibl. Ind. **1**: 418. 1878, in part; Coult. Man. Bot. Rocky Mt. 119. 1885, in part.

Pseudocymopterus anisatus (Gray) Coult. & Rose, Rev. N. Am. Umbell. 75. 1888, in part; Howell, Fl. N. W. Am. **1**: 258. 1898, in part; Coult & Rose, Contr. U. S. Nat. Herb. **7**: 189. 1900, in part; Rydb. Fl. Col. 257. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909, in part; Nels. Spring Fl. Intermt. States, 118. 1912, in part; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Tidestrom, Contr. U. S. Nat. Herb. **25**: 399. 1925 [Fl. Utah & Nev.].

P. Hendersoni Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 190. 1900.

Pseudopteryxia anisata (Gray) Rydb. Bull. Torr. Bot. Club **40**: 71. 1913, in part; Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922.

[78] Gray, Proc. Acad. Phila. **1863**: 63. 1864.

P. longiloba Rydb. Bull. Torr. Bot. Club **40:** 72. 1913; Fl. Rocky Mts. 623. 1917, and ed. 2. 623. 1922.

P. Hendersoni (Coult. & Rose) Rydb. Fl. Rocky Mts. 624, 1064. 1917, and ed. 2. 624. 1922.

Pseudocymopterus anisatus var. *longilobus* (Rydb.) Tidestrom, Contr. U. S. Nat. Herb. **25:** 399. 1925 [Fl. Utah & Nev.].

Plants acaulescent from a long thickened tap-root crowned with persistent leaf bases, 0.5–4 dm. high, glabrous; leaves narrowly oblong in general outline, excluding the petiole, 1.3–9.5 cm. long, 1–2.5 cm. broad, bipinnatisect, ultimate segments linear, acute, mostly distinct, 1–15 mm. long, 0.5–2 mm. broad, petiole 1–11 cm. long; peduncles usually exceeding the leaves, umbels several-rayed, rays of each umbel subequal, 3–30 mm. long, involucre absent or rarely present as one or two inconspicuous or conspicuous linear bracts, involucel bracts conspicuous, mostly exceeding the yellow flowers, 2–12 mm. long, rarely somewhat scarious-margined, linear-lanceolate, entire or bifid, occasionally fused with the pedicels for a portion of their length; fruit ovate-oblong, 4–7 mm. long, 2–4 mm. broad, calyx teeth persistent, conspicuous, lateral wings present, linear or sublinear in cross-section, acute at the apex, dorsal wings 1–3, similar to, or somewhat smaller than, the lateral wings, oil tubes 1–5 in the intervals, 3–8 on the commissure, accessory oil tubes rarely present in the wings, strengthening cells absent or present.

Type specimen: *Henderson 4068*, summit of peak, source of Mill Creek, Idaho, 12,800 ft. alt., 21 Aug. 1895 (TYPE in the United States National Herbarium; photograph of the type in the Missouri Botanical Garden Herbarium).

Distribution: southern Idaho to northern New Mexico, central Colorado west to eastern Nevada.

Specimens examined:

WYOMING: stony draws, Ridge, Albany Co., 18 June 1901, *Goodding 35* (G, M, NY, P, R, US); head of Poison Spider, Garfield Peak, 29 July 1894, *A. Nelson 649* (R); Ft. Steele, 18 June 1898, *A. Nelson 4803* (G, M, NY, R, US); moist soil, under cliffs, Chug Creek, Albany Co., 1 July 1900, *A. Nelson 7361* (G, M, MU, NY, P, R, US); stony summits, Teton Mts., Uinta Co., 16 Aug. 1899, *Nelson & Nelson 6507* (G, M, MU, NY, R, US); Ferris

Mts., 25 July 1898, *E. Nelson 4969* (M, NY, R); Wind River & Owl Creek, 1873, *Parry 122* (G); rock field, mountains 5 miles east of Afton, Lincoln Co., 10,100 ft. alt., 3 July 1923, *Payson & Armstrong 3337* (G, M, PA R); rock ledge, Tetons, Jackson's Hole, Lincoln Co., 10,500 ft. alt., 13 Aug. 1920, *Payson & Payson 2281* (G, M, NY, R); Gravel Mt., Teton Forest Reserve, 9000 ft. alt., Aug. 1897, *Tweedy 309* (NY); eastern slope of the Big Horn Mountains, headwaters of Clear Creek and Crazy Woman River, 7000–9000 ft. alt., 20 July–15 Aug. 1900, *Tweedy 3369* (NY, R, WSC); dry sandy plains and rocky hills, Mt. Steele, Fort Steele, Carbon Co., 7500 ft. alt., 25 May–10 June 1901, *Tweedy 4514* (NY, US).

Colorado: mountains, Red Cliff, 8000 ft. alt., 2 July 1894, *Bethel 36-4* (US); headwaters of Clear Creek, and the alpine ridges lying east of "Middle Park," 1861, *Parry 157* (G, M, NY, PA); vicinity of Georgetown, 28 June–7 Aug. 1875, *Patterson* (F 62567, 88293); high mountains about Gray's Peak, 10,000–12,000 ft. alt., 6 July–4 Aug 1885, *Patterson 40* (CH, F, G, M, US); Silver Plume, 21 Aug. 1895, *Rydberg* (NY); West Spanish Peak, 2800–3000 m. alt., 6 July 1900, *Rydberg & Vreeland 5813* (NY, R, US); Little Veta Mountain, 3000–3300 m. alt., 22 June 1900, *Rydberg & Vreeland 5814* (NY, US); Clear Lake, Georgetown, 17 Aug. 1895, *Shear 4527* (NY, US).

New Mexico: face of cliff in the box, vicinity of Brazos Canyon, Rio Arriba Co., 5 Sept. 1914, *Standley & Bollman 11165* (US).

Idaho: summit of peak, source of Mill Creek, 12,800 ft. alt., 21 Aug. 1895, *Henderson 4068* (US type, M photograph); rock slides near summit, Caribou Mountain, Bonneville Co., 19 July 1923, *Payson & Armstrong 3557* (G, M, PA, R).

Utah: Silver Lake, Big Cottonwood, 30 Sept. 1909, *Clemens* (NY); in clefts in rock, Big Cottonwood Canyon, Mt. Wolverine, Salt Lake Co., 10,000 ft. alt., 28 June 1905, *Garrett 1307* (G, PA, R); in crevices in cliff, Big Cottonwood Canyon, Wasatch Mts., Salt Lake Co., 8800 ft. alt., 15 Aug. 1905, *Garrett 1620* (G, NY, PA, US); grassy soil, Fish Lake, Uintah Mts., 17 July 1902, *Goodding 1382* (G, M, NY, F, US); Alta, 10,000 ft. alt., 7 July 19—, *M. E. Jones* (P 82107); Little Cottonwood Cañon, Wasatch Mts., 11,000 ft. alt., 23 Aug. 1904, *M. E. Jones* (M, US 855704,

856687); La Sal Mts., 13 June 1913, *M. E. Jones* (D 148718); Bald Mt., Alta, Wasatch Mts., 12,500 ft. alt., 12 Aug. 1879, *M. E. Jones 1233* (F, G, NY, US); gravel, Mt. Ellen Park, Henry Mts., 10,000 ft. alt., 24–25 July 1894, *M. E. Jones 5677* (M, NY, R, US); Tate Mine, Marysvale, 11,700 ft. alt., 28 Aug. 1894, *M. E. Jones 5933* (NY, R); edge of snow bank, Peterson Cañon, Peterson, 8000–10,500 ft. alt., 19 July 1902, *Pammel & Blackwood 3827* (G); rock slide, La Sal Mts., Grand Co., 10,500 ft. alt., 21 July 1924, *Payson & Payson 3941* (G, M, R); Sierra La Sal, May–Oct. 1899, *Purpus* (M); Sierra La Sal, May–Oct. 1901, *Purpus* (US 505333); Logan, Aug. 1895, *Rydberg* (NY); Big Cottonwood Cañon, between Silver Lake and the summit of Mount Majestic, 28 June 1905, *Rydberg & Carlton 6370* (NY); Big Cottonwood Cañon, between Silver Lake and the summit of Mount Majestic, 28 June 1905, *Rydberg & Carlton 6389* (G, NY, R); mountains around the south fork of Big Cottonwood Creek, 3 July 1905, *Rydberg & Carlton 6598* (G, NY); mountains north of Bullion Creek, near Marysvale, 23 July 1905, *Rydberg & Carlton 7085* (NY, R, US); mountains north of Bullion Creek, near Marysvale, 23 July 1905, *Rydberg & Carlton 7096* (NY); Mount Barette, 26 July 1905, *Rydberg & Carlton 7207* (NY, US); divide between Sevier and Beaver Rivers, near Belcnap Peak, 28 July 1905, *Rydberg & Carlton 7337* (NY, R, US); La Sal Mountains, 3000–3300 m. alt., 7 July 1911, *Rydberg & Garrett 8723* (NY, R, US); La Sal Mountains, 3000–3300 m. alt., 7 July 1911, *Rydberg & Garrett 8724* (G, M, NY); La Sal Mountains, near Mount Peal, 3300–3700 m. alt., 17 July 1911, *Rydberg & Garrett 9015* (NY); Abajo Mountains (eastern range), 3000–3300 m. alt., 17 Aug. 1911, *Rydberg & Garrett 9760* (MU, NY); Abajo Mountains (eastern range), 3000–3300 m. alt., 17 Aug. 1911, *Rydberg & Garrett 9761* (NY, US); extreme summit of mt., Ogden, about 12,000 ft. alt., 6 Aug. 1887, *S. M. Tracy 621* (CH); Observatory Peak, Ogden, 11,000 ft. alt., 6 Aug. 1887, *Tracy & Evans 621* (NY); moist soil among rocks, La Sal Mts., Grand Co., 12,000 ft. alt., 15 July 1912, *Walker 281* (G, M, MU, NY, R, US).

Nevada: canyon at the head of South Fork of the Humboldt, Elko Co., 10,300 ft. alt., 11 Aug. 1908, *A. A. Heller 9389* (NY, PA, US); Aurum, 11 July 1891, *M. E. Jones* (M); E. Humboldt Mts., 8000 ft. alt., Aug. 1868, *Watson 453* (G, NY, US).

5. P. humboldtensis (Jones) Mathias, new comb.

Pl. 25, fig. 19; pl. 36, fig. 1.

Cymopterus humboldtensis Jones, Contr. West. Bot. 12: 21, 28. 1908; Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 447. 1909.

Plants acaulescent, 0.4–1 dm. high, from a long slender taproot, glabrous; leaves narrowly oblong in general outline, excluding the petiole, 1–2.5 cm. long, about 1 cm. broad, bi–tri-pinnatisect, ultimate segments linear, acute, distinct, 1–2 mm. long, about 1 mm. broad, petiole somewhat sheathing at the base, less than 1 cm. long; peduncles exceeding the leaves, 2–7 cm. long, umbels few-rayed, rays less than 5 mm. long, involucre absent, involucel bracts linear, acute, occasionally due to the short rays appearing as involucre bracts, sometimes purplish-tinged; fruit oblong, 4–6 mm. long, 3–4 mm. broad, wings well-developed, oil tubes 5–6 in the intervals, about 10 on the commissure.

Type specimen: *M. E. Jones*, above Clover Valley, East Humboldt Mts., Nevada, about 11,000 ft. alt., 2 Aug. 1901 (TYPE in the Herbarium of Pomona College, cotypes in the New York Botanical Garden Herbarium and the Rocky Mountain Herbarium of the University of Wyoming).

Distribution: known only from the type locality.

Specimens examined:

NEVADA: East Humboldt Mts., 10,000 ft. alt., 13 Aug. 1897, *M. E. Jones* (P 78791); East Humboldt Mts., 2 Aug. 1901, *M. E. Jones* (P 78787 TYPE, NY, R 113462).

6. P. bipinnatus (Wats.) Coult. & Rose, Rev. N. Am. Umbell. 75. 1888; Heller, Cat. N. Am. Pl. 98. 1898, and ed. 2. 151. 1900; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 190. 1900; Rydb. Mem. N. Y. Bot. Gard. **1**: 288. 1900; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 361. 1909.

Pl. 22, fig. 10; pl. 34, fig. 2.

Cymopterus bipinnatus Wats. Proc. Am. Acad. **20**: 368. 1885; Coult. Man. Bot. Rocky Mt. 119. 1885; Jones, Contr. West. Bot. 12: 28. 1908.

Cynomarathrum Macbridei Nels. Bot. Gaz. **54**: 142. 1912.

Pseudoreoxis bipinnatus (Wats.) Rydb. Bull. Torr. Bot. Club **40**: 73. 1913; Fl. Rocky Mts. 621. 1917, and ed. 2. 621. 1922.

Plants acaulescent, 0.2–2.6 cm. high, caespitose from long slender tap-roots; leaves rough-puberulent, narrowly oblong in general outline, excluding the petiole, 1.5–6.5 cm. long, 0.5–1.5 cm. broad, bi-tri-pinnatisect, ultimate segments acute, crowded, 1–4 mm. long, 0.5–1 mm. broad, petiole 2–9 cm. long; peduncles greatly exceeding the leaves, umbels several-rayed, rays 1–17 mm. long, involucre absent, involucel bracts about equalling the white flowers, linear, acute, more or less confluent at the base, scarious with a prominent mid-nerve, occasionally purplish-tinged; fruit ovate-oblong, 3–6 mm. long, 3–6 mm. broad, lateral wings present, in cross-section oblong-linear to subdeltoid, dorsal wings 3, similar to the laterals, oil tubes 1–7 in the intervals, 4–8 on the commissure, strengthening cells absent.

Type specimen: *Hayden 14*, Rocky Mountains, south of Virginia City, Montana, 25–30 June 1871 (TYPE in the Gray Herbarium of Harvard University).

Distribution: western Montana and adjacent Idaho to Oregon.

Specimens examined:

MONTANA: summit of Mt. Helena, May 1887, *F. W. Anderson* (M); Mt. Helena, 2 June 1887, *F. W. Anderson* (NY); *Blankinship* (US 371710); Lower Trail Cr., Park Co., 2 July 1899, *Blankinship* (US 441452); dry ridges, Trail Cr., Bridger Mts., Park Co., 8000 ft. alt., 29 June, 2 July 1899, *Blankinship 225* (M, PA); dry ridges, Trail Creek, Park Co., 2 July 1899, Helena, 19 May 1905, *Blankinship 225* (F); dry ridges, Helena, 19 May 1905, *Blankinship 225* (US); Tobacco Mts., 14 July 1909, *Butler 5048* (NY); rocks, Mt. Helena, Helena, 6 July 1883, *Canby 148* (CH, G, PA, WSC); Rocky Mts., s. of Virginia City, 25–30 June 1871, *Hayden 14* (G TYPE); Lima, 14 July 1908, *M. E. Jones* (NY); Sedan, Gallatin Co., 7 June 1902, *W. W. Jones* (G); Mt. Helena, 5 May 1888, *Kelsey* (MU 164806, US 44725); Helena, April 1889, *Kelsey* (F 91679, MU 164810, 164811); Helena, 9 May 1891, *Kelsey* (NY); Helena, June 1891, *Kelsey* (F 397697, MU 164803, P 78786); Helena, 29 June 1891, *Kelsey* (NY); Helena, 16 June 1892, *Kelsey* (F 91982, MU 164802, 164807); Helena, 10 June 1887, June 1888, *Kelsey 133* (N, US); May 1888, *Kelsey 3194* (F); on open, clay hilltops, Monida, Madison Co., 16 June 1899, *Nelson & Nelson 5411* (G, M, MU, NY, US);

Cedar Mountain, 16 July 1897, *Rydberg 4630* (US); Pole Creek, Madison Co., 7000 ft. alt., 4 July 1897, *Rydberg & Bessey 4628* (MU, NY, US); Cedar Mountain, 10,000 ft. alt., 16 July 1897, *Rydberg & Bessey 4629* (F, G, NY, US); Cedar Mountain, 10,000 ft. alt., 16 July 1897, *Rydberg & Bessey 4630* (NY); Livingston, 1 May 1901, *Scheuber* (MU 164804); Livingston, 20 May 1902, *Scheuber* (US 541294); Shields River, 6 June 1883, *Scribner 66c* (CH, G, US); Helena, May 1893, *Starz* (M 713531); rocky slopes, 7000–8000 ft. alt., June 1888, *Tweedy* (US 44724); rocky slopes, Madison Co., 7000–8000 ft. alt., May–June 1888, *Tweedy 1* (CH, NY); ridge above Bannock, 7000 ft. alt., 19 July 1880, *Watson 158* (G); Helena, 30 April 1886, *R. S. Williams 516* (MU, US).

IDAHO: mountain tops near Challis, 8000 ft. alt., 3 Aug. 1895, *Henderson 3810* (US); alpine summit of mountain, Clyde, Blaine Co., 10,000 ft. alt., 10 July 1916, *Macbride & Payson 3123* (G, M, NY); shale slides, Mackay, Bear Canyon, Custer Co., 10,000 ft. alt., 31 July 1911, *Nelson & Macbride 1502* (G, M); white shale outcrop, Mt. Baldy, Salmon, Lemhi Co., 6500 ft. alt., 1 July 1920, *Payson & Payson 1866* (G, M, NY, R); rocky soil, high open ridges, Spencer, about 7500 ft. alt., 15 June, 9 July 1916, *Rust 537* (US).

OREGON: summit of Stein's Mountains, 15 July 1898, *Cusick 2040a* (P, US).

7. P. nivalis (Wats.) Mathias, new comb. Pl. 36, fig. 2.

Cymopterus nivalis Wats. Bot. King's Exp. 123. 1871; Bibl. Ind. **1**: 419. 1878; Coult. & Rose, Rev. N. Am. Umbell. 78. 1888; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 185, 191. 1900.

Pseudoreoxis nivalis (Wats.) Rydb. Bull. Torr. Bot. Club **40**: 73. 1913.

Plants acaulescent, 0.5–1.5 dm. high, from a long slender tap-root; leaves narrowly oblong in general outline, excluding the petiole, 1.5–5 cm. long, 0.5–1.5 cm. broad, simply or bi-pinnatisect, rough-puberulent, ultimate segments linear to ovate, acute, distinct, 1–10 mm. long, 1–4 mm. broad, petioles slightly sheathing, 1–8 cm. long; peduncles exceeding the leaves, 4–10 cm. long,

umbels few-rayed, rays less than 5 mm. long, involucre absent, involucel bracts dimidiate, subconnate at the base, linear, acute, about equalling the white or pinkish flowers; mature fruit not seen, young fruit ovate-oblong, about 1.5 mm. long, about 1 mm. broad, wings thin, oil tubes inconspicuous.

Type specimen: *Watson 448*, E. Humboldt Mts., Nevada, 9000 ft. alt., July 1868 (TYPE in the United States National Herbarium, cotypes in the Gray Herbarium of Harvard University and the New York Botanical Garden Herbarium).

Distribution: known only from the type locality.

Specimens examined:

NEVADA: E. Humboldt Mts., 9000 ft. alt., July 1868, *Watson 448* (US TYPE, G, NY).

X

PTERYXIA Nutt.

Pteryxia Nutt. acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 170. 1900; Piper & Beattie, Fl. Palouse Region, 128. 1901; Piper, Contr. U. S. Nat. Herb. **11**: 429. 1906 [Fl. Wash.]; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 357. 1909; Nels. Spring Fl. Intermt. States, 116. 1912; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Piper & Beattie, Fl. S. E. Wash. 184. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 485. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 620. 1917, and ed. 2. 620. 1922; Smiley, Univ. Calif. Publ. Bot. **9**: 280. 1921 [Fl. Sierra Nev. Calif.]; Tidestrom, Contr. U. S. Nat. Herb. **25**: 396. 1925 [Fl. Utah & Nev.].

Cymopterus § *Pteryxia* Nutt. in Torr. & Gray, Fl. N. Am. **1**: 624. 1840.

Herbaceous, acaulescent or caulescent, glabrous perennials with long slender tap-roots. Leaves petiolate, thin, bi–quadri-pinnatisect; ultimate leaf divisions 1–8 mm. long, 0.5–1 mm. wide; petioles slightly sheathing. Inflorescence spreading, peduncle exceeding the leaves; involucre mostly absent; involucel bracts inconspicuous, linear to lance-attenuate; calyx teeth evident; flowers white or yellow; stylopodium lacking. Fruit ovate to ovate-oblong, flattened dorsally; lateral wings present; dorsal wings similar to or shorter than the laterals; wings thin, narrow in

cross-section; oil tubes small, 3–12 in the intervals, 5–20 on the commissure, sometimes occurring at the base of the wings in cross-section; strengthening cells absent or present; seed face somewhat concave.

Type species: **Pteryxia terebinthina** (Hook.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 171. 1900.

KEY TO SPECIES

A. Leaves ovate-oblong to broadly ovate in general outline, mostly quadripinnatisect.
  B. Wings of the fruit more or less undulate-crisped; plants of the Walla Walla and Yakima regions of Washington and Oregon. . *1. P. terebinthina*
  BB. Wings of the fruit mostly not undulate-crisped.
    C. Flowers mostly yellow; fruit over 5 mm. long.
      D. Leaves mostly green, segments narrow; umbel rays usually short; fruit 5–10 mm. long, 3–4 mm. broad, dorsal wings usually reduced; plants of eastern Washington and adjacent regions. . . . . *1a. P. terebinthina* var. *foeniculacea*
      DD. Leaves mostly gray-green, segments broader; umbel rays mostly short; fruit 5–8 mm. long, 3–5 mm. broad, dorsal wings usually well-developed; plants of western Wyoming and adjacent regions. . . . . *1b. P. terebinthina* var. *calcarea*
      DDD. Leaves mostly gray-green, segments broader; umbel rays mostly longer, up to 80 mm. long; fruit 5–10 mm. long, 5–10 mm. broad, dorsal wings mostly well-developed; plants of northeastern California and adjacent Nevada. . . . . *1c. P. terebinthina* var. *californica*
    CC. Flowers whitish; fruit 3–5 mm. long. . . . . . . *1d. P. terebinthina* var. *albiflora*
AA. Leaves narrowly oblong in general outline, bipinnatisect. . . . . . *2. P. petraea*

1. P. terebinthina (Hook.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 171. 1900; Piper, Contr. U. S. Nat. Herb. **11**: 429. 1906 [Fl. Wash.]; Piper & Beattie, Fl. S. E. Wash. 184. 1914.
Pl. 25, figs. 20–21; pl. 37, fig. 1.

Laserpitium terebinthinum Dougl. acc. to Hook. Fl. Bor.-Am. **1**: 266. 1834, in synonymy.

Selinum terebinthinum Hook. Fl. Bor.-Am. **1**: 266, *pl. 95*. 1834.

Cymopterus terebinthinus (Hook.) Torr. & Gray, Fl. N. Am. **1**: 624. 1840; Walp. Rep. Bot. Syst. **2**: 418. 1843; Brew. & Wats. Bot. Calif. **1**: 266. 1876, in part; Wats. Bibl. Ind. **1**: 419. 1878, in part; Macoun, Cat. Can. Pl. **1**: 186. 1883, in part; Coult. Man. Bot. Rocky Mt. 118. 1885, in part; Coult. & Rose, Rev. N. Am. Umbell. 79. 1888, in part; Greene, Fl.

Franciscana, 327. 1891, in part; Howell, Fl. N. W. Am. **1**: 258. 1898, in part; Heller, Cat. N. Am. Pl. ed. 2. 151. 1900; Rydb. Mem. N. Y. Bot. Gard. **1**: 292. 1900, excl. *Tweedy no. 213;* Jeps. Man. Fl. Pl. Calif. 730. 1925.

Pteryxia terebinthacea Nutt. acc. to Torr. & Gray, Fl. N. Am. **1**: 624. 1840, in synonymy.

"*Cymopterus terebinthinus* Dougl." acc. to Eaton & Wright, N. Am. Bot. 216. 1840.

"*Seseli terebinthinum* Hook. Fl. Bor.-Amer. 1, p. 266, t. 95" acc. to Gray, Bot. Ives' Exp. 15. 1860.

Plants caulescent or sometimes subacaulescent, 1–6 dm. high, from a long slender tap-root crowned with persistent leaf bases, glabrous; leaves ovate-oblong to broadly ovate in general outline, excluding the petiole, 3–18 cm. long, 3–12 cm. broad, mostly quadripinnatisect, ultimate segments linear to subcuneate, rigid, acute, mucronulate, more or less confluent, 1–4 mm. long, about 1 mm. broad, gray-green, petiole slightly sheathing at the base, 2–16 cm. long; peduncles stout, exceeding the leaves, umbels spreading, 7–24-rayed, rays unequal, 5–70 mm. long, involucre mostly absent, involucel bracts lance-attenuate, equalling or slightly exceeding the yellow or whitish flowers; fruit ovate to ovate-oblong, 7–11 mm. long, 7–10 mm. broad, wings thin, usually undulate-crisped, dorsal wings mostly similar to the laterals, rarely shorter, oil tubes 3–12 in the intervals, 6–20 on the commissure, sometimes occurring at the base of the wings.

Type specimen: *Douglas*, "Common on the sandy grounds of the Wallawallah River, North-West coast of America" (TYPE in the Kew Herbarium, photograph of the type in the Missouri Botanical Garden Herbarium).

Distribution: the Walla Walla and Yakima regions of Washington and adjacent Oregon.

Specimens examined:

WASHINGTON: Pasco, Franklin Co., June 1902, *H. P. Baker* (M 255); Walla Walla region, June 1883, *T. S. Brandegee 803* (G); stony gulches, Prosser, Yakima Co., 27 May 1903, *Cotton 1080* (US, WSC); on the sandy grounds of Wallawallah River, *Douglas* (K TYPE, M photograph); Connell, Franklin Co., May 1902, *A. J. A. Elmer 52* (NY); Atahnum (Ahtanum) River, 31 May

1899, *Flett 1295* (WSC); dry creek bottom n. of Rattlesnake Mountains, near Barrel Springs, Moxee to North Yakima, 31 May 1902, *Griffiths & Cotton 39* (WSC); Moxee to North Yakima, June 1902, *Griffiths & Cotton 39* (NY, US); dry ground, Prosser, Yakima Co., Pasco, Franklin Co., 26 May, 11 June 1892, *Henderson* (WSC 17292); dry, sunny bluff-tops near snow-line, Mt. Adams, 7 Aug. 1882, *Henderson 380* (M); dry, sunny alpine ledges, Mt. Adams, 10 Aug. 1882, *Henderson 380* (CH); dry ground, Prosser & Mt. Adams, Yakima Co., Pasco, Franklin Co., 26 May, 12 June, 13 Aug. 1892, *Henderson 380* (US); Pasco, 25 May 1896, *Hindstraw* (WSC 17289); Columbia River near the mouth of Alder Creek, 27 April 1882, *T. Howell* (NY); Columbia River & Mt. Adams, 1 May, 15 Aug. 1882, *T. J. Howell* (CH 366243, F 96892, MU 164843, NY); Ladybug Hill, Donald, Yakima Co., 26 June 1921, *Ihrig* (WSC 37768); Burbank, Walla Walla Co., 29 May 1922, *Lechiner 6* (WSC); Hunt's Junction, 19 Apr. 1898, *Leckenby* (US 622112, WSC 17294); Cascade Mountains to Fort Colville, about Lat. 49° N., 1860, *Lyall* (G); R. Mts., Wt. slope to W. Walla, *Nuttall* (NY, PA); Pasco, 26 May 1899, *Piper 2980* (WSC); dry sand, southwest of Moses Lake, Grant Co., 1000–1150 ft. alt., 25 June 1921, *St. John, Courtney & Parker 4943* (M, WSC); on drifting sand, Three Mile School, Wallula, Walla Walla Co., 5 April 1923, *St. John, Hardy & Warren 3072* (M, WSC); 15 miles w. of Hanford, Benton Co., 7 April 1927, *St. John, Jones, English & Mullen 8111* (WSC); dry sand, Vantage Ferry, Grant Co., 12 April 1924, *St. John, Pickett, Cary & Warren 6308* (WSC); Wilson Creek, 1000–2000 ft. alt., June 1893, *Sandberg & Leiberg* (IAC 35918, MU 164844, 164845); sandy soil at camp 6 near Crab and Wilson Creeks, Douglas Co., 685 m. alt., 19 June 1893, *Sandberg & Leiberg 230* (CAL, F, G, M, NY, US, WSC); valley of the Swauk River, Kittitas Co., 750–1800 m. alt., May–Sept. 1913, *Sharples 163* (G); loose volcanic soil, Falcon Valley, 3 June, July 1883, *Suksdorf* (F 97441, PA, US 33334); low dry grounds in Falcon Valley, Aug. 1882, *Suksdorf 129* (G); sandy plains, near Morgan's Ferry, Yakima River, 7 June 1884, *Suksdorf 317* (G); Mt. Paddo (Adams), 4000–5000 ft. alt., 10 Aug. 1885, *Suksdorf 1201* (US); Dog Creek near Cooks, Skamania Co., 2 July 1923, *Suksdorf*

11480 (G); Sylvan Lake, Odessa, Lincoln Co., 22 June 1918, *Taylor 408* (WSC).

Oregon: *T. Howell* (NY); John Day's Valley, May 1880, *T. Howell 272* (G); John Day's River, June 1880, *Howell & Howell* (US 44719); Umatilla, 500 ft. alt., 1 June 1905, *M. E. Jones* (M, NY, US 855649, 856464); 1887, *Parry* (PAR); 188–, *Parry 65* (PAR); dry ground, Umatilla, 11 July 1915, *Peck 6313* (G); dry ground near Boardman, Morrow Co., 14 June 1928, *J. W. Thompson 4778* (M).

The plate of this species in Hooker's 'Flora' shows a conspicuous conical stylopodium. This is evidently an error since a stylopodium does not occur in the genus. There is a pronounced disk present and it was probably confused with a stylopodium by the artist, as no mention of a stylopodium is made in the specific description and there is no plant, as far as known, which possesses a conical stylopodium and the other characters shown by the illustration.

1a. P. terebinthina var. **foeniculacea** (Nutt.) Mathias, new comb. Pl. 25, figs. 24-26.

Cymopterus foeniculaceus (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 624. 1840; Walp. Rep. Bot. Syst. **2**: 418. 1843; Wats. Bot. King's Exp. 124. 1871, in part.

Pteryxia foeniculacea Nutt. acc. to Torr. & Gray, Fl. N. Am. **1**: 624. 1840, in synonymy; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 171. 1900; Piper & Beattie, Fl. Palouse Region, 128. 1901; Rydb. Fl. Col. 254. 1906, in part; Piper & Beattie, Fl. S. E. Wash. 184. 1914; Rydb. Fl. Rocky Mts. 621. 1917, in part, and ed. 2. 621. 1922, in part; Tidestrom, Contr. U. S. Nat. Herb. **25**: 396. 1925 [Fl. Utah & Nev.].

Cymopterus thapsoides (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 625. 1840.

Pteryxia thapsoides Nutt. acc. to Torr. & Gray, Fl. N. Am. **1**: 625. 1840, in synonymy; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 172. 1900.

Cymopterus thaploides Torr. & Gray acc. to Walp. Rep. Bot. Syst. **2**: 418. 1843, err. typ.

Pteryxia foeniculacea (Torr. & Gray) Nutt. acc. to Piper, Contr. U. S. Nat. Herb. **11**: 430. 1906 [Fl. Wash.].

Cymopterus Elrodi Jones, Bull. Univ. Mont. XV. 61: 41. 1910.

Pteryxia Elrodi (Jones) Rydb. Fl. Rocky Mts. 621, 1064. 1917, and ed. 2. 621. 1922.

Plants mostly more slender than in the species; leaf segments greener, mostly longer and less rigid; umbel more compact, rays mostly shorter, subequal; fruit narrower, 5–10 mm. long, 3–4 mm. broad, wings not undulate-crisped, dorsal wings mostly shorter than the laterals.

Type specimen: *Nuttall*, "On rocks, Blue Mountains of Oregon" (TYPE in the Herbarium of the Academy of Natural Sciences, Philadelphia, cotypes in the New York Botanical Garden Herbarium and the Gray Herbarium of Harvard University).

Distribution: eastern Washington, Oregon, Idaho and western Montana.

Specimens examined:

MONTANA: Alta, 4500 ft alt., 22 July 1909, *M. E. Jones* (P 82159, 82160).

IDAHO: near Bay Horse, Custer Co., 5800 ft. alt., 5 Aug. 1895, *Henderson 3811* (US); Cuddy Mts., 11 July 1899, *M. E. Jones* (US 44668); Weiser, 6 June 1899, *M. E. Jones 3* (US); Cuddy Mts., 11 July 1899, *M. E. Jones 28* (US); Weiser, Wash. Co., 2200 ft. alt., 6 July 1899, *M. E. Jones 6348* (M, US); Cuddy Mts., Wash. Co., 6000 ft. alt., 11 July 1899, *M. E. Jones 6350* (M, US); Shoup, 1919, *Kemp 73* (NY); loose, clayey hillsides, Challis Creek, Custer Co., 6000 ft. alt., 19 July 1916, *Macbride & Payson 3315* (M); Aberdeen, Bingham Co., 23 June 1921, *Piper* (WSC); vicinity of Pocatello, 1923, *Soth 221* (NY).

WASHINGTON: Walla Walla region, May 1882, *T. S. Brandegee 800* (G); Palouse Falls, Whitman Co., 6 May 1923, *Brode 1* (WSC); rocky crevices, Lewis Pk., Blue Mts., Col. Co., 27–29 May 1923, *Brode 5* (WSC); 2 miles below Wilma, Whitman Co., 16 April 1922, *R. H. Brown* (WSC 48324); Rock Creek, 6 miles below Rock Lake, Whitman Co., 14 May 1903, *Cotton 957* (WSC); rocky open places, Tallow Flat, Columbia Co., 25 June 1913, *Darlington 245* (R); in crevices of rocks on moist north hillsides, Wawawai, Whitman Co., May 1897, *A. D. E. Elmer 770* (M, MU, NY, P, US, WSC); summit of range along Salmon Riv., Blue Mountains, 9 Aug. 1897, *Horner 305* (WSC); Blue

Mts., Garfield Co., 9 Aug. 1897, *Horner R 305* (G); Clark Springs, 10 mi. n. Spokane, 8 July 1902, *Kreager 119* (G, MU, NY, US, WSC); Blue Mts., 4 July 1892, *Lake & Hull 535* (G); stony bluffs of Snake River, n. w. bank 6 mi. below Lewiston, Whitman Co., 6 April 1922, *Parker 306* (WSC); in loose rock on high ridges of the Blue Mts., Walla Walla Co., 15 July 1896, *Piper 2340* (NY, US); rocky cliffs of Snake River, Almota, 2 May 1897, *Piper 2795* (US, WSC); lime talus, mth. of Grand Ronde, Asotin Co., 9 May 1925, *H. St. John 3518* (M, WSC); Devil's Canyon, Kahlotus, Franklin Co., 10 April 1927, *H. St. John 8051* (WSC); rocky hillside, Wilma, Whitman Co., 27 April 1924, *St. John, Cowan & Warren 3301* (A, WSC); on rocky slopes above Palouse Falls, Franklin Co., 8 April 1923, *St. John, Hardy & Warren 3111* (M, WSC); 1889, *Vasey 309* (NY, US).

Oregon: near Strawberry Butte, Blue Mountains, 8250 ft. alt., 13 July 1896, *Coville 554* (US); rocky subalpine ridges, July–Aug. 1886, *Cusick 1396* (G, US); Union, 1897, *Cusick 1651* (US); Logan Valley, southern Blue Mountains, 20 June 1897, *Cusick 1657* (M, MU, N, US, WSC); Wallowa Mountains, near the lake, 5000–6000 ft. alt., 23 Aug. 1898, *Cusick 2085* (F, M, MU, N, US, WSC); stony ridge, s. slope Wallowa Mts., 7000 ft. alt., 16 July 1900, *Cusick 2443a* (US); rocks of Camp Creek, Maurey's Mts., 1 July 1901, *Cusick 2627* (F, G, M, MU, NY, P, R, US); Mitchell, 15 May 1885, *T. Howell 422* (G); near Hoover Creek, Gilliam Co., 1390 m. alt., 1 June 1894, *Leiberg 134* (F, NY, US); Blue Mts., Et. of W. Walla, *Nuttall* (PA type, G, NY); dry stony slope, Fossil, Wheeler Co., 5 July 1921, *Peck 10064* (NY, WSC); Deschutes Canyon, Redmond, Crook Co., 18 July 1920, *Whited 257* (WSC); among rocks, Deschutes Canyon, vicinity of Redmond, Deschutes Co., 1 May 1921, *Whited 257* (IAC, PA, R); among rocks, Crook Co., 12 June 1921, *Whited 257* (M).

1b. P. terebinthina var. **calcarea** (Jones) Mathias, new comb. Pl. 25, figs. 28–29; pl. 38, fig. 1.

Cymopterus calcareus Jones, Contr. West. Bot. 8: 32. 1898; Heller, Cat. N. Am. Pl. ed. 2. 151. 1900.

Pteryxia calcarea (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 173. 1900; Coult. & Nels. Man. Bot. Cent. Rocky

Mts. 357. 1909; Nels. Spring Fl. Intermt. States, 116. 1912; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Rydb. Fl. Rocky Mts. 621. 1917, and ed. 2 621. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 396. 1925 [Fl. Utah & Nev.].

Plants mostly lower than in the species, acaulescent or shortly caulescent; leaves mostly tripinnatisect, segments somewhat broader, mostly gray-green; umbel more compact, rays usually shorter, subequal; fruit narrower, 5–8 mm. long, 3–5 mm. broad, wings mostly not undulate-crisped, dorsal wings similar to or shorter than the laterals.

Type specimen: *M. E. Jones*, Green River, Wyoming, 6000 ft. alt., 23 June 1896 (TYPE in the Herbarium of Pomona College, cotypes in the Missouri Botanical Garden Herbarium and the United States National Herbarium).

Distribution: southern Montana to central Utah, northwestern Colorado to eastern Nevada.

Specimens examined:

MONTANA: Bridger Canyon, 20 July 1898, *Blankinship* (US 441454); n. of Ft. Ellis, Bozeman, 17 May 1899, *Blankinship* (US 441453); Bridger Canyon, 2 May 1900, *Blankinship* (R 89808); dry ridges, Bridger Mts., 5000–6000 ft. alt., 26 May, 17 July 1905, *Blankinship 226* (M, PA); dry ridges, Bridger Mts., 5000–6000 ft. alt., 13–17 June 1905, *Blankinship 226* (US); dry ridges, Bridger Mts., 6000 ft. alt., 13 June, 17 July 1905, *Blankinship 226* (F); near electric power house, Bozeman, Gallatin Co., 23 May 1900, *Chesnut & Jones 164* (US); Bozeman, 24 May 1901, *Moore* (US 416263); rocky hills, Bozeman, Gallatin Co., 5000 ft. alt., July 1887, *Tweedy 213* (D).

WYOMING: high gravelly hillside, Thermopolis, 30 June 1924, *Bartholomew 8738* (R); mountain side, head of Powder River, Big Horn Co., 19 July 1901, *Goodding 322* (G, M, NY, R, US); western slope of Wind River Mountains, 8000 ft. alt., 1 June 1860, *Hayden* (M); Green River, 6000 ft. alt., 23 June 1896, *M. E. Jones* (P 82014 TYPE, M, US 359177, 735595); dry soil, Leucite Hills, 17 June 1901, *Merrill & Wilcox 477* (G, NY, R, US); Steamboat Mt., Sweetwater Co., June 1900, *A. Nelson* (R 28830); on rocky sandstone slopes, Point of Rocks, Sweetwater Co., 1 June 1897, *A. Nelson 3083* (G, M, NY, R, US); Leroy, 7 June

1898, *A. Nelson 4584* (G, M, NY, R); Cokeville, 11 June 1898, *A. Nelson 4643* (R, US); stony draws and foothills, Steamboat Mt., Sweetwater Co., 9 June 1900, *A. Nelson 7065* (G, M, MU, NY, P, R, US); in the bad-lands, Powder River, Natrona Co., 27 June 1910, *A. Nelson 9389* (G, MU, R); Little Sandy, 1873, *Parry* (G); stony slopes near summit, Sheep Mountain (Ferry Peak), Snake River Range, near Alpine, Lincoln Co., 11 July 1923, *Payson & Armstrong 3452* (G, M, R); dry hillsides, Teton Pass Mts., east of Victor, Idaho, 7500, 9000 ft. alt., 22 July 1920, *Payson & Payson 2073* (G, M, NY, R); dry sagebrush slope, 15 mi. north of Rock Springs, 5 July 1922, *Payson & Payson 2563* (R); sagebrush slopes, plains between Eden and Big Piney, Sublette Co., 6 July 1922, *Payson & Payson 2585* (F, G, M, NY, PA, R, US); sagebrush slopes, Horse Creek, 7 miles west of Merna, Sublette Co., 17 July 1922, *Payson & Payson 2737* (F, G, M, NY, PA, R, US); red clay slopes in the vicinity of Green River Lakes, Sublette Co., 9500 ft. alt., 11 Aug. 1925, *Payson & Payson 4662* (G, M, PA, R, WSC); rocky soil near river, Pearson's Ranch, Clark, 4000 ft. alt., 23 June 1925, *Pearson 239* (R); Fort Bridger, 8 July 1873, *Porter* (G, US 44714); LaBarge, June 1894, *Stevenson 12* (US); La Barge, Uinta Co., 21 June 1894, *Stevenson 33* (US).

Colorado: below Steamboat Springs, Routt Co., 17 June 1903, *Osterhout 2782* (NY, P); Columbia, 8700 ft. alt., 4 July 1901, *Tweedy 4513* (NY).

Idaho: open, stony points at base of peak, south end of Soldier Mts., Blaine Co., 8000 ft. alt., 26 June 1916, *Macbride & Payson 2902* (G, M, NY, R, US); dry open slopes near base of peak, Caribou Mountain, Bonneville Co., 19 July 1923, *Payson & Armstrong 3563* (G, M, PA, R).

Utah: Cache Co., June 1890, *Dodge* (NY); Detroit, 25 May 1891, *M. E. Jones* (R 26717); Dugway, 26 May 1891, *M. E. Jones* (M in part); Detroit, June 1891, *M. E. Jones* (US 44667); Dutch Mt., 12 June 1891, *M. E. Jones* (CAL 372880, G, NY); Thistle, 5300 ft. alt., 23 June 1898, *M. E. Jones 6340* (US); Dutch Mt., Tooele Co., 5300 ft. alt., 15 June 1900, *M. E. Jones 6349* (NY, US); Bear River Canyon, Box Elder Co., 20 June 1909, *C. P. Smith 1681* (F, R); Logan Canyon, Cache Co., 18 April 1911, *C. P. Smith 2325* (NY).

NEVADA: Cobre, 6000 ft. alt., 16 June 1906, *M. E. Jones* (D 148733).

1c. P. terebinthina var. californica (Coult. & Rose) Mathias, new comb. Pl. 25, figs. 22–23; pl. 37, fig. 2.

Pteryxia californica Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 172. 1900; Smiley, Univ. Calif. Publ. Bot. **9**: 280. 1921 [Fl. Sierra Nev. Calif.].

Cymopterus californicus (Coult. & Rose) Jones, Contr. West. Bot. 12: 27. 1908.

C. terebinthinus var. *californicus* (Coult. & Rose) Jeps. Man. Fl. Pl. Calif. 730. 1925.

Plants mostly as stout or stouter than in the species, shortly caulescent; leaf segments not rigid, gray-green; umbel more or less spreading, rays 10–80 mm. long; fruit 5–10 mm. long, about as broad, wings not undulate-crisped, thicker than in the species, dorsal wings mostly similar to the laterals.

Type specimen: *H. E. Brown*, Sisson, Siskiyou Co., California, 1897 (TYPE in the United States National Herbarium).

Distribution: California, from Siskiyou County south to the region of Yosemite National Park, and adjacent Nevada.

Specimens examined:

NEVADA: Little Valley, Washoe Co., 2000–2155 m. alt., 24 July 1902, *C. F. Baker 1369* (F, G, M, NY, P, R, US); east side of Mount Rose, Washoe Co., 8450 ft. alt., 10 June 1913, *A. A. Heller 10942* (F, M, NY, PA, R); Carson City, 5000 ft. alt., 29 May 1897, *M. E. Jones* (CAL 303389, M, US 359185); foothills, Carson City, 6000 ft. alt., 2 June 1897, *M. E. Jones* (M, NY, US 359178).

CALIFORNIA: Spanish Peak, *Austin* (CH 361192); summit of Humboldt R. R. between Chico and Prattville, June 1896, *Austin 72* (M); Colby, Butte Co., July 1896, *Austin 72* (US); Lassen Peak, Aug. 1896, *Austin 540* (M); Cisco, 1872, *Bolander* (G); Yosemite Valley, 1866, *Bolander 6345* (G, US); *Bolander & Kellogg* (US 140753); Alta Meadows, 5 Aug. 1905, *K. Brandegee* (M 793611, NY, R 83505, US 1200327); dry hills, Ebbett's Pass, 9000 ft. alt., 1863, *Brewer 1988* (G); Sisson, Siskiyou Co., 1897, *H. E. Brown* (US 299990 TYPE); Siskiyou Co., 5 July 1920, *M. S. Clemens* (NY); on rocky open hill-top, Jonesville, Butte Co.,

1750 m. alt., 13 July 1929, *Copeland* (CAL); Mineral King, Sierra Nevada, 2750 m. alt., 31 July 1891, *Coville & Funston 1392* (G, US); Sequoia Nat. Park, July 1908, *Davidson 2075, 2087* (US); Little Yosemite, 13 July 1902, *Eastwood 12* (US); Deer Park, Lake Tahoe region, 15–19 June 1912, *Eastwood 435* (G, NY, US); trail from Morgans Springs to Lassen Butte, 22–26 Aug. 1912, *Eastwood 1826* (G, NY, US); Summit, Sierra Nevada, C. P. R. R., July 1877, *Edwards* (NY); Feather River Meadows, Lassen Forest, Plumas Co., 1600 m. alt., 14, 15 July 1911, *Eggleston 7239* (US); Jason & Stewart's Camp, headwaters of Hat Creek, Lassen Forest, Shasta Co., 2120 m. alt., 31 July–1 Aug. 1911, *Eggleston 7438* (US); Dardenelles Creek, Clarks Fork Trail, Stanislaus Forest, Tuolumne Co., 2100 m. alt., 15, 17 June 1913, *Eggleston 9369* (US); on Cloud's Rest, 1872, *Gray* (G); near Salt Creek, Shasta Co., 1400 ft. alt., June 1903, *Hall & Babcock* (R 46991); near Salt Creek, Shasta Co., 1400 ft. alt., June 1903, *Hall & Babcock 4015* (US); lava-beds of northeastern Shasta Co., 4000 ft. alt., June 1903, *Hall & Babcock 4230* (US); Collins Meadow, Fresno Co., 7500 ft. alt., July 1900, *Hall & Chandler 541* (M, MU, NY, US); Little Summit near Butte Meadows, Butte Co., 22 June 1914, *A. A. Heller* (M 748222); near Castle Peak, Nevada Co., 7500 ft. alt., 31 July 1903, *A. A. Heller 7070* (F, G, M, MU, NY, PA, R, US); near Middle Creek Station, Shasta Co., 3 June 1905, *A. A. Heller 7953* (F, G, M, NY, PA, US); summit of Sierra Nevada above Jonesville, Butte Co., 7000 ft. alt., 26 June 1915, *A. A. Heller 12029* (F, G, NY, US); common on Spring Hill near the town of Mt. Shasta, Siskiyou Co., 22 July 1921, *A. A. Heller 13585* (F, M, NY); in gravelly soil, Spring Hill near Sisson, Siskiyou Co., 3550 ft. alt., 22 July 1921, *A. A. Heller 13585* (US); open gravelly places on Spring Hill near Sisson, Siskiyou Co., 9 June 1928, *A. A. Heller 14597* (M); above Yosemite, 1877, *Hooker & Gray* (G); Ebbett's Pass, Sierra Nevada, 1877, *Hooker & Gray* (G); Lassen Peak, 6000 ft. alt., 8 July 1897, *M. E. Jones* (M, US); Soda Springs, Nevada Co., 9 July 1902, *M. E. Jones* (NY); Summit, 8000 ft. alt., 26 July 1900, *M. E. Jones 6339* (M); 1868–9, *Kellogg & Harford 319* (US); in crevices of rocks on Grizzly Hill, 5800 ft. alt., 12 July 1900, *Leiberg 5114* (US); on wet mountain slope

near Webber Lake, 7500 ft. alt., 3 Aug. 1900, *Leiberg 5248* (US); Sierra Nev. Mts., 1875, *J. G. Lemmon* (US 44683); near Edgewood, 27 June 1889, *J. G. Lemmon 45* (CAL, US); 1875, *J. G. Lemmon 112* (F, G, NY, PAR); Sierra Co., 1875, *J. G. Lemmon 985* (G, M, PAR); Lake Tahoe, El Dorado Co., about 8000 ft. alt., Oct. 1909, *McGregor* (US 592374); Heather Lake, 7800 ft. alt., 24 Aug. 1909, *McGregor 183* (NY, US); Desolation Valley, Tahoe, 8600 ft. alt., 16 July 1913, *Smiley 97* (G); Tuolumne Meadows, Yosemite, 8500 ft. alt., 11 Aug. 1916, *Smiley 706* (G); dry gravelly ground on road to Tahoe, Placer Co., 6 June 1886, *Sonne* (F 97801, IAC 91585); dry gravelly ground, Donner Lake and above Summit, Placer Co., 8000 ft. alt., June 1891, Sept. 1892, *Sonne* (NY); Yosemite Valley and mountains, 1865, *Torrey* (NY); near Donner Lake, Sierra Nevada, 1865, *Torrey 167* (G, NY); Big Bar, on dry chaparral hills, Trinity Co., 1400 ft. alt., 31 May 1926, *J. P. Tracy 7548* (CAL); dry gravel, Tuolumne Meadows, Tuolumne Co., 8600 ft. alt., 19 July 1907, *Ware 2681c* (G).

This variety contains many different leaf types and the plants range greatly in size so that certain of the extremes would appear to be specifically distinct. However, due to the intergrading forms and the great altitudinal range through which the variety occurs it has been concluded that such variations as occur are unworthy of varietal or formal designation.

1d. P. terebinthina var. albiflora (Nutt.) Mathias, new comb. Pl. 25, fig. 27.

Cymopterus albiflorus (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 625. 1840; Walp. Rep. Bot. Syst. **2**: 418. 1843.

Pteryxia albiflora Nutt. acc. to Torr. & Gray, Fl. N. Am. **1**: 625. 1840, in synonymy; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 173. 1900; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 358. 1909; Nels. Spring Fl. Intermt. States, 116. 1912; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Rydb. Fl. Rocky Mts. 621. 1917, and ed. 2. 621. 1922.

Cymopterus terebinthinus var. *albiflorus* (Nutt.) Jones, Contr. West. Bot. 10: 56. 1902, as to synonymy.

Plants low, acaulescent or shortly caulescent; leaf segments

gray-green; umbel compact, rays 5–15 mm. long; fruit 3–5 mm. long, about as broad, wings short, thicker than in the species.

Type specimen: *Nuttall*, "Hills of Bear River, in the Rocky Mountain range" (TYPE in the Herbarium of the Academy of Natural Sciences, Philadelphia, cotypes in the Gray Herbarium of Harvard University and the New York Botanical Garden Herbarium).

Distribution: northwestern Wyoming and adjacent Montana and Idaho.

Specimens examined:

MONTANA: Red Lodge, 26 July 1893, *Rose 48* (G, M, NY, US).

WYOMING: 7 Sept. 1893, *Rose 533* (US).

IDAHO: Bear River, *Nuttall* (PA TYPE, G, NY).

The species which have been described in the *Pteryxia terebinthina* group have proved puzzling for many years. In this study it has been concluded that they represent geographical variants which due to different habitats have developed certain characteristics distinguishing them from the *terebinthina* type. However, because of the large number of intermediate forms and the fact that the various elements are limited to well-defined geographical areas they are here given varietal rank. *Pteryxia terebinthina* is primarily characterized by the broad, comparatively thin, more or less undulate-crisped wings of the fruit. The foliage is generally less fine than in its variety *foeniculacea* and is most nearly approached by varieties *calcarea* and *californica.* The variety *calcarea* on the one hand shows relationships with variety *foeniculacea* and on the other hand with *californica.*

Specimens collected by Suksdorf in Falcon Valley, Washington, and here referred to *P. terebinthina* because of the prominent thin wings, are intermediate in foliage characters between that species and its variety *foeniculacea. Suksdorf no. 11480* and *St. John, Courtney and Parker no. 4943*, referred to *P. terebinthina*, show a tendency toward the variety *californica. Kreager no. 119* in fruit characters shows an intergradation between variety *foeniculacea,* to which it is referred, and variety *californica.* *Jones no. 3* and *6348* from Weiser, Idaho, referred to variety *foeniculacea,* show tendencies toward both the species

P. terebinthina and the variety *californica*. Jones' specimens from Detroit, Utah, indicate the relation between varieties *calcarea* and *californica*. *Osterhout no. 2782* and Blankinship's collections from Bozeman, Montana, connect the variety *calcarea* with *foeniculacea*. *Payson & Payson no. 4662* is intermediate between the variety *calcarea*, under which it is placed, and *P. terebinthina*.

These specimens are the more conspicuous ones indicating the great intergradation of characters connecting these varieties with the species. Future collections and field studies in the intervening areas, particularly in southeastern Oregon, northern Nevada and southern Idaho, may not only connect the varieties geographically but may show them to be phases of a polymorphic species and unworthy of varietal designation.

2. **P. petraea** (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 172. 1900; Rydb. Fl. Rocky Mts. 621. 1917, and ed. 2. 621. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 396. 1925 [Fl. Utah & Nev.]. Pl. 25, figs. 30–31; pl. 38, fig. 2.

Cymopterus petraeus Jones, Contr. West. Bot. 8: 32. 1898; Heller, Cat. N. Am. Pl. ed. 2. 151. 1900.

Plants caulescent from a long slender tap-root crowned with persistent leaf bases, 1.5–4.5 dm. high, glabrous; leaves narrowly oblong in general outline, excluding the petiole, 3.5–17 cm. long, 0.5–5 cm. broad, bipinnatisect, ultimate segments linear, acute, distinct, 1–8 mm. long, 0.5–1 mm. broad, petiole 5–12 cm. long; peduncles slender, exceeding the leaves, umbels several-rayed, rays 1–55 mm. long, the inner rays conspicuously shortened or obsolete, involucre absent, involucel bracts inconspicuous, linear; flowers yellow; fruit ovate to ovate-oblong, 4.5–7 mm. long, 2–4 mm. broad, calyx teeth persistent, lateral wings present, linear or sublinear in cross-section, mostly acute at the apex, dorsal wings 1–3, mostly 3, similar to or shorter than the laterals, oil tubes 3–8 in the intervals, 5–15 on the commissure, accessory oil tubes mostly absent; strengthening cells inconspicuous.

Type specimen: *M. E. Jones*, Palisade, Nevada, 14 June 1882 (TYPE in the Herbarium of Pomona College, cotypes in the New York Botanical Garden Herbarium and the United States National Herbarium).

Distribution: southeastern Oregon and southern Idaho to west-central Nevada and adjacent California.

Specimens examined:

Idaho: sage-brush flats, Twin Falls, 12 May 1912, *Bennitt 37* (R); crevices of bluffs, Shoshone Falls, 25 July 1897, *Henderson 4597* (US); crevices in recent lava, Martin, Blaine Co., 6000 ft. alt., 5 July 1916, *Macbride & Payson 3053* (M, NY, R, US); lava cliff crevices, Shoshone Falls, Twin Falls Co., 3700 ft. alt., 24 June 1912, *Nelson & Macbride 1720* (G, M, MU, NY, R, US); Shoshone Falls, 4 June 1893, *E. Palmer 104* (R, US).

Nevada: Palisade, 14 June 1882, *M. E. Jones* (P 82056 type, 82059, NY, US 49396,); Corey Canon, Wassuk Mts., 2040 m. alt., 27 June 1919, *Tidestrom 10124* (M, NY, US); W. Humboldt Mts., 8000 ft. alt., June 1868, *Watson 452* (G).

Oregon: on rocks, Stein's Mts., June 1885, *Cusick 1255* (G, US); cliff-sides of Stein's Mountains, 2 July 1898, *Cusick 1995* (F, M, MU, N, P, US, WSC); Stein's Mountain, 3 June 1885, *T. Howell 423* (G); Alvord Desert, 1280 m. alt., 30 June 1896, *Leiberg 2426* (F, G, NY, US).

California: rocky soil, Inyo Mts., 5000–6000 ft. alt., May–Oct. 1898, *Purpus 5792* (US); piñon belt, Wyman Cañon, White Mts., Inyo N. F., 13 June 1919, *Tidestrom 9882* (NY, US).

XI

AULOSPERMUM Coult. & Rose

Aulospermum Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 174. 1900; Rydb. Fl. Col. 253. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 358. 1909; Garrett, Spring, Fl. Wasatch Reg. 68. 1911, and ed. 4. 111. 1927; Nels. Spring Fl. Intermt. States, 117. 1912; Clem. & Clem. Rocky Mt. Fl. 226. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 481. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 618. 1917, and ed. 2. 618. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.].

Cymopterus § *Coriophyllus* Jones, Contr. West. Bot. 12: 20. 1908.

C. § *Scopulicola* Jones, Contr. West. Bot. 12: 27. 1908, in part.

Coriophyllus (Jones) Rydb. Bull. Torr. Bot. Club **40**: 69. 1913, non *Coriophyllum* Setchell & Gardn. Univ. Calif. Publ. Bot. **6**:

396. 1917, nec *Cardamine* § *Coriophyllum* O. E. Schulz, Bot. Jahrb. **32**: 326. 1903.

Herbaceous, acaulescent, or subcaulescent with the development of a pseudoscape, glabrous or pubescent perennials with long more or less slender tap-roots. Leaves petiolate, thin, bi–quadri-pinnatisect; ultimate leaf divisions 1–20 mm. long, 0.5–4 mm. wide; petioles somewhat sheathing. Inflorescence subcompact to spreading, peduncles equalling or exceeding the leaves; involucre absent or present; involucel mostly dimidiate, of triangular or linear greenish or purplish bracts; calyx teeth present; flowers white, purple or yellow; stylopodium lacking. Fruit oblong to ovate in general outline, flattened slightly dorsally; lateral and dorsal wings present; wings linear throughout or conspicuously inflated at the base in cross-section; oil tubes small, 1–8 in the intervals, 2–22 on the commissural side, rarely solitary in the base of the wings in cross-section; strengthening cells at the base of the wing inconspicuous or conspicuous; seed face slightly to deeply concave.

Type species: **Aulospermum longipes** (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 175. 1900.

KEY TO SPECIES

A. Pseudoscape conspicuous.
  B. Involucre mostly absent, involucel of more or less inconspicuous short bracts.
    D. Plants essentially glabrous.
      F. Leaves ovate-oblong in general outline; rays of the umbel 3–30 mm. long; flowers yellow; wings of the fruit well-developed or the dorsal wings more or less aborted; plants of central Utah, western Wyoming and adjacent Idaho and Colorado .... *1. A. longipes*
      FF. Leaves mostly oblong in general outline; rays of the umbel 5–45 mm. long; flowers purple; wings of the fruit short; plants of northwestern Colorado .... *2. A. planosum*
      FFF. Leaves oblong to ovate-oblong in general outline; rays of the umbel 5–20 mm. long; flowers white; wings of the fruit well-developed; plants of western Utah and eastern Nevada .... *3. A. ibapense*
    DD. Plants scabrous-puberulent .... *5. A. Watsoni*
  BB. Involucre present, involucel of conspicuous elongated, linear-acuminate bracts .... *4. A. glaucum*
AA. Pseudoscape absent or inconspicuous.
  C. Leaves scabrous-puberulent to hirtellous.

E. Plants tall, 0.9–3.5 dm. high; leaves mostly quadripinnatisect, segments mostly distinct; fruit 6–11 mm. long, 5–8 mm. broad.......................................*6. A. aboriginum*

EE. Plants low, 0.3–0.8 dm. high; leaves mostly tripinnatisect, segments mostly confluent; fruit 4–5 mm. long, about 3 mm. broad...*7. A. minimum*

CC. Leaves glabrous except for an occasional roughening on the margins and veins.

G. Leaves bi–tri-pinnatisect, ultimate segments mostly confluent, appearing as lobes of a broad cuneate or subcuneate leaflet.

M. Primary rays of the umbel stout, secondary rays or pedicels obsolete; involucel bracts conspicuously dimidiate, mostly ovate................*8. A. basalticum**

MM. Primary rays of the umbel less stout, secondary rays or pedicels present and comparatively conspicuous; involucel bracts not conspicuously dimidiate, mostly linear.

H. Rays of the umbel 5–20 mm. long, more or less scaberulent; plants of south-central Utah..............*9. A. Rosei*

HH. Rays of the umbel 20–45 mm. long, glabrous; plants of northeastern Utah ....*10. A. duchesnense*

GG. Leaves tri–quadri-pinnatisect, ultimate segments mostly distinct.

J. Ultimate segments of the leaves not spinulose; plants of Colorado, Utah, and adjacent New Mexico and Arizona.

K. Involucel bracts shorter than the purple or greenish-yellow flowers; fruit oblong to ovate-oblong in general outline, wings narrow or slightly enlarged at the base in cross-section, oil tubes 1–8 in the intervals, 3–11 on the commissure..*11. A. purpureum*

KK. Involucel bracts about equalling the purple flowers; fruit broadly ovate in general outline, wings conspicuously inflated at the base in cross-section, oil tubes solitary in the intervals, 2 on the commissure..............................*12. A. Jonesii*

JJ. Ultimate segments of the leaves somewhat spinulose; plants of California.

L. Leaf divisions not remote, ultimate segments 1–5 mm. long; plants primarily of the Panamint and Argus Mountains..........*13. A. panamintense*

LL. Leaf divisions remote, ultimate segments 3–20 mm. long; plants of the Mohave Desert. ....*13a. A. panamintense* var. *acutifolium*

* See p. 399 for description.

1. **A. longipes** (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 175. 1900; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 358. 1909; Garrett, Spring Fl. Wasatch Reg. 68. 1911, and ed. 4. 112. 1927; Nels. Spring Fl. Intermt. States, 117. 1912; Clem. & Clem. Rocky Mt. Fl. 226. 1914; Rydb. Fl. Rocky Mts. 618. 1917, and ed. 2. 618. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.]. Pl. 22, fig. 9; pl. 25, fig. 1; pl. 39.

Cymopterus longipes Wats. Bot. King's Exp. 124. 1871; Bibl. Ind. **1**: 418. 1878; Coult. & Rose, Rev. N. Am. Umbell. 79. 1888; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900.

Peucedanum lapidosum Jones, Zoe **2**: 246. 1891; Heller, Cat. N. Am. Pl. 98. 1898.

Cymopterus lapidosus Jones, Contr. West. Bot. 8: 31. 1898; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 185. 1900; Heller, Cat. N. Am. Pl. ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 25. 1908; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 360. 1909; Clem. & Clem. Rocky Mt. Fl. 228. 1914; Tidestrom, Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.].

Aulospermum angustum Osterh. Bull. Torr. Bot. Club **31**: 358. 1904; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 359. 1909; Rydb. Fl. Rocky Mts. 618. 1917, and ed. 2. 618. 1922.

Cymopterus lapidosus var. *deserti* Jones, Contr. West. Bot. 12: 21. 1908; Coult & Rose, Contr. U. S. Nat. Herb. **12**: 447. 1909.

"*Aulospermum angustatum* Osterh." acc. to Coult & Rose, Contr. U. S. Nat. Herb. **12**: 446. 1909.

Cogswellia lapidosa (Jones) Rydb. Fl. Rocky Mts. 627, 1064. 1917, and ed. 2. 627. 1922.

Lomatium lapidosum (Jones) Garrett, Spring Fl. Wasatch Reg. ed. 4. 110. 1927.

Plants subcaulescent with the development of a conspicuous pseudoscape, 0.3–3.5 dm. high, glabrous; leaves ovate-oblong in general outline, excluding the petiole, 1.5–8 cm. long, 1–7.5 cm. broad, sometimes conspicuously glaucous, tripinnatisect, the primary divisions sometimes confluent with a wing development of the rhachis, ultimate segments mostly acute, mucronulate, closely confluent, 1–7 mm. long, 1–4 mm. broad, petiole 1–14 cm.

long; mature peduncles equalling or exceeding the leaves, 3–26 cm. long, umbels several-rayed, rays spreading, 3–30 mm. long, involucre absent, involucel of several linear, acute to acuminate bracts about equalling the yellow flowers; fruit oblong to ovate-oblong in general outline, 5–9 mm. long, 3–6 mm. broad, wings well-developed or the dorsal wings more or less aborted, narrow at the base in cross-section, oil tubes 3–7 in the intervals, 4–9 on the commissure; seed face deeply concave.

Type specimen: *Watson 451*, Wahsatch Mts., near Salt Lake City, and on Antelope Island, Utah, 5000 ft. alt., May 1869 (TYPE in the United States National Herbarium, cotype in the Gray Herbarium of Harvard University).

Distribution: Colorado, western Wyoming and adjacent Idaho, to central Utah.

Specimens examined:

WYOMING: head of Muddy, 4 May 1860, *Hayden* (M); Granger, 6000 ft. alt., 24 June 1896, *M. E. Jones* (D 148781, P 82592); Carter, 6000 ft. alt., 25 June 1896, *M. E. Jones* (P 82593); Piedmont, 7 June 1898, *A. Nelson 4574* (G, M, R, US); Piedmont, 7 June 1898, *A. Nelson 4575* (G, M, P, R, US); Green River, 14 June 1898, *A. Nelson 4710* (R); clay slopes, hills east of Afton, Lincoln Co., 7200 ft. alt., 25 June 1923, *Payson & Armstrong 3270* (G, M, R); stony ridge, mountains 5 miles east of Afton, Lincoln Co., 9300 ft. alt., 3 July 1923, *Payson & Armstrong 3359* (G, M, R); steep clay slopes, mountains near Cottonwood Lake, east of Smoot, Lincoln Co., 10,300 ft. alt., 9 Aug. 1923, *Payson & Armstrong 3781* (G, M, R); calcareous summit, Teton Pass Mts., east of Victor, Idaho, 10,100 ft. alt., 25 July 1920, *Payson & Payson 2132* (G, M, R); rocks near summit, Piney Mt., 25 miles west of Big Piney, Sublette Co., 12 July 1922, *Payson & Payson 2696* (R); subalpine slide, Gros Ventre Mountains, 15 miles northeast of Bondurant, Sublette Co., 15 Aug. 1922, *Payson & Payson 3040* (R); red soil slopes, in the vicinity of Green River Lakes, Sublette Co., 10,300 ft. alt., 5 Aug. 1925, *Payson & Payson 4540* (R).

COLORADO: Steamboat Springs, July 1891, *Eastwood* (CAL 106613); below Steamboat Springs, Routt Co., 17 June 1903, *Osterhout 2783* (R, US); Hayden, Routt Co., 27 May 1915, *Osterhout 5225* (R).

IDAHO: Preston, 13 May 1909, *M. P. Henderson 33* (R); Oxford, 4 April 1885, *Leonard* (G); dry mineral deposit of extinct spring, Soda Springs, Bannock Co., 5700 ft. alt., 18 June 1920, *Payson & Payson 1726* (G, M, R).

UTAH: 1873, *Bishop* (F 34602, G); 1872, *Bishop 25* (US); Fort Douglas, 24 April 1908, *Clemens* (D 28546, F 345272, G); Big Cottonwood Canyon, 28 May 1908, *Clemens* (F 384997, M); Big Cottonwood Canyon, 29 May 1908, *Clemens* (US 690434); Big Cottonwood Canyon, 3 May 1909, *Clemens* (D 28540, US 619781); Big Cottonwood Canyon, 6 May 1909, *Clemens* (G); Big Cottonwood Canyon, 13 May 1909, *Clemens* (F 345316); Big Cottonwood Cañon, 12 April 1910, *Clemens* (P 82204); Big Cottonwood Cañon, 15 April 1910, *Clemens* (P 82205, R 96137); Ephraim Canyon, Hanti National Forest, Wasatch Mountains, 7500 ft. alt., 3 June 1908, *Clos 10* (US); dry foothills, Temple Hill, 4600 ft. alt., 15 April 1924, *Decker & Eggertson 288* (BYU); rocks in City Creek Cañon, Wasatch Mountains, 29 June 1880, *G. Engelmann* (M); hills near Camp Floyd, 17 April 1859, *H. Engelmann* (M); west side of Gen. Johnston's Pass, 3 May 1859, *H. Engelmann* (M); Salt Lake City, Salt Lake Co., 4500 ft. alt., May 1903, *Garrett* (G); 18--, *M. E. Jones* (CAL 20953); Juab, 3 April 1880, *M. E. Jones* (US 227175); Salt Lake City, 8 May 1880, *M. E. Jones* (D 149835); Salt Lake City, May 1882, *M. E. Jones* (D 125987); Echo, 7 May 1890, *M. E. Jones* (D 129620, 149843, 149844, G, M, P 82101, US 47026); Homansville, 16 May 1891, *M. E. Jones* (D 125988, M); Sandy, 4500 ft. alt., 24 May 1895, *M. E. Jones* (D 149838, M, R 48922, US 238310, 359181, WSC 16957); City Creek Cañon, S. L. Co., 5500 ft. alt., 3–4 April 1896, *M. E. Jones* (CAL 303386, D 149837, M, R 48926, US 279306, 359182); Provo Cañon, Utah Co., 5500 ft. alt., 8 June 1896, *M. E. Jones* (P 82102); Midway, 16 May 1901, *M. E. Jones* (D 149836); Big Cottonwood, 6000 ft. alt., 2 May 1908, *M. E. Jones* (CAL 303384, CAS 139277, D 149841, M, P 82104, US 855705); Theodore, benches of the Uintahs, 8000 ft. alt., 13 May 1908, *M. E. Jones* (D 149842, P 82103, US 856686); Theodore, 15 miles south, 7500 ft. alt., 18 May 1908, *M. E. Jones* (P 82105); Utah Valley, 5000 ft. alt., 3 May 1880, *M. E. Jones 1680* (CH); Fairview, 6500 ft. alt., 30 June 1894, *M. E. Jones 5554e* (US);

Fairview, 6000 ft. alt., 13 July 1894, *M. E. Jones 5627b* (US); Bacchus, Salt Lake Co., 30 March 1915, *W. W. Jones 203* (G); Magna, 21 May 1914, *W. W. Jones 204* (G); hills and mountains, north of Salt Lake City, 9–12 June 1905, *Rydberg 6005* (US); 4600 ft. alt., 10 May, *Sears* (M); Logan, April 1911, *C. P. Smith* (P 82591); along the railroad, Logan, Cache Co., 3 April 1909, *C. P. Smith 1519* (R); hillsides east of U. A. C., Logan, Cache Co., 15 April 1909, *C. P. Smith 1523* (F); racing track, Logan, Cache Co., 18 April 1909, *C. P. Smith 1526* (F); north fork, Logan Canyon, Cache Co., 10 May 1909, *C. P. Smith 1564* (R); along the railroad, Logan, Cache Co., 16 May 1909, *C. P. Smith 1577* (R); near mouth of Logan Canyon, Logan, Cache Co., 18 April 1911, *C. P. Smith 2330* (D); "Wheelon" hillsides, Collinston, Box Elder Co., 1 May 1911, *C. P. Smith 2345* (D); east bench, Salt Lake City, 4500 ft. alt., 10 May 1900, *Stokes* (D 28543, MU 163447, US 404281); Ephraim Cañon, Wasatch Mts., 2100 m. alt., 18 May 1908, *Tidestrom 1016* (US); common on slopes, Thistle Junction, 1500 m. alt., 11 May 1909, *Tidestrom 2052* (US); Wahsatch Mts., 5000 ft. alt., May 1869, *Watson 451* (US TYPE, G).

2. **A. planosum** Osterh. Bull. Torr. Bot. Club **30**: 236. 1903; Rydb. Fl. Col. 254. 1906; Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 446. 1909; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 359. 1909; Rydb. Fl. Rocky Mts. 618. 1917, and ed. 2. 618. 1922. Pl. 41, fig. 1.

Plants subcaulescent with the development of a conspicuous pseudoscape, 1–3 dm. high; leaves mostly oblong in general outline, excluding the petiole, 1–6 cm. long, 1–3 cm. broad, sometimes minutely roughened, mostly tripinnatisect, the primary divisions remote, the ultimate segments acute, incurved, confluent, 1–4 mm. long, about 1 mm. broad, petiole 1–6 cm. long; mature peduncles exceeding the leaves, 4–17 cm. long, umbels several-rayed, rays spreading, 5–45 mm. long, slightly roughened, involucre absent, involucel of several linear, acute bracts about equalling the purple flowers; fruit oblong in general outline, 5–7 mm. long, 2–3 mm. broad, wings short, narrow at the base in cross-section, oil tubes 3–4 in the intervals, about 6 on the commissure, seed face deeply concave.

Type specimen: *Osterhout 2572*, "along the Eagle River at Minturn, Eagle Co.," Colorado, 5 June 1902 (TYPE in the Herbarium of the New York Botanical Garden, cotypes in the Rocky Mountain Herbarium of the University of Wyoming, and the herbaria of Pomona College and the United States National Museum).

Distribution: northwestern Colorado.

Specimens examined:

COLORADO: on Yampa River, Routt Co., 15 July 1891, *Eastwood* (US 55439); Minturn, Eagle Co., 5 June 1902, *Osterhout 2572* (P, R, US, cotypes); Minturn, Eagle Co., 13 June 1903, *Osterhout 2744* (G, P); Steamboat Springs, Routt Co., 16 June 1903, *Osterhout 2771* (R); Tongue Creek, Mesa Gr., Delta Co., 7000 ft. alt., June 1892, *Purpus 83* (CAL, CH); Spanbridges Pick, Mesa Gr., Delta Co., 7800–8000 ft. alt., May, June 1892, *Purpus 196* (CAL, CH).

3. **A. ibapense** (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 359. 1909; Garrett, Spring Fl. Wasatch Reg. 68. 1911, and ed. 4. 112. 1927; Nels. Spring Fl. Intermt. States, 117. 1912; Clem. & Clem. Rocky Mt. Fl. 227. 1914; Rydb. Fl. Rocky Mts. 618. 1917, and ed. 2. 618. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.]. Pl. 40, fig. 1.

Cymopterus ibapensis Jones, Zoe **3**: 302. 1893; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 25. 1908.

Plants subcaulescent with the development of a conspicuous pseudoscape, 0.5–2 dm. high, glabrous (leaves in dried specimens appearing roughened due to an irregular wrinkling of the epidermis); leaves oblong to ovate-oblong in general outline, excluding the petiole, 1–9 cm. long, 0.5–4 cm. broad, mostly glaucous, tripinnatisect, the primary divisions more or less remote, ultimate segments rounded to acute, confluent, 1–8 mm. long, 1–2 mm. broad, petiole 1–6 cm. long; mature peduncles exceeding the leaves, 4–16 cm. long, umbels several-rayed, rays somewhat spreading, 5–20 mm. long, involucre absent, involucel of a few inconspicuous linear bracts, about equalling the white flowers;

fruit ovate-oblong in general outline, 4–10 mm. long, 4–5 mm. broad, wings well-developed, narrow at the base in cross-section, oil tubes 3–7 in the intervals, 4–6 on the commissure, seed face deeply concave.

Type specimen: *M. E. Jones*, alkaline soil, Deep Creek Valley, Utah, 6 June 1891 (TYPE in the United States National Herbarium, cotypes in the Gray Herbarium of Harvard University, the Rocky Mountain Herbarium of the University of Wyoming, and the herbaria of the University of California and the Missouri Botanical Garden).

Distribution: western Utah and eastern Nevada in the region of the fortieth parallel.

Specimens examined:

UTAH: alkaline soil, Deep Creek Valley, 6 June 1891, *M. E. Jones* (US 49881 TYPE, 47079, CAL 172659, G, M, R 26720); on Deep Creek, Furber, June 1891, *M. E. Jones* (P 82110); below Devine's, 8 June 1891, *M. E. Jones* (P 82109); Fort Cove, 22 May 1923, *M. E. Jones* (P 117310); Dog Valley, 22 May 1923, *M. E. Jones* (P 117309).

NEVADA: near Panaca, Lincoln Co., 18 May 1891, *Bailey 1974* (US); 1891, *A. J. Jones* (M); Centreville, 6300 ft. alt., 3 June 1893, *M. E. Jones* (CAL 303385, D 149839, M, US 238311, WSC 16959); Duck Creek, 7500 ft. alt., 30 June 1893, *M. E. Jones* (D 149840, M, US 238313); Muncy, 17 May 1906, *M. E. Jones* (P 82108).

4. **A. glaucum** (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900; Rydb. Fl. Rocky Mts. 618. 1917, and ed. 2. 618. 1922. Pl. 40, fig. 2.

Cymopterus glaucus Nutt. Jour. Acad. Phila. **7**: 28. 1834; Torr. & Gray, Fl. N. Am. **1**: 624. 1840; Eaton & Wright, N. Am. Bot. 215. 1840; Walp. Rep. Bot. Syst. **2**: 418. 1843; Wats. Bibl. Ind. **1**: 418. 1878; Coult. & Rose, Rev. N. Am. Umbell. 81. 1888; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Rydb. Mem. N. Y. Bot. Gard. **1**: 293, 1900.

Plants subcaulescent with the development of a conspicuous pseudoscape, 0.3–3 dm. high, glabrous; leaves oblong to ovate-oblong in general outline, 1.5–9 cm. long, 1–7 cm. broad, some-

times conspicuously glaucous, tripinnatisect, the primary divisions more or less remote, the ultimate segments obtuse to acute, sometimes mucronulate, closely confluent, 1 mm. long, about as broad, petiole 0.5–7 cm. long; mature peduncles exceeding the leaves, 1–14 cm. long, umbels few-rayed, rays spreading, 2–30 mm. long, involucre of one to several conspicuous linear-acuminate bracts, involucel similar to the involucre, equalling or exceeding the yellow flowers; fruit oblong in general outline, 5–7 mm. long, about 3 mm. broad, wings short, narrow at the base in cross-section, oil tubes 3–4 in the intervals, about 6 on the commissure, seed face deeply concave.

Type specimen: *Nuttall*, "on the borders of Flat-Head River towards the sources of the Columbia," Montana, April (TYPE in the Herbarium of the Academy of Natural Sciences, Philadelphia, cotypes in the Gray Herbarium of Harvard University and the New York Botanical Garden Herbarium).

Distribution: western Montana and north-central Idaho.

Specimens examined:

MONTANA: "Oregon," 1860, *Bearsall 810* (US); rocks near lakes at the headwaters of Jocko River, 15 July 1883, *Canby 147* (G); hills, Missoula, 3600 ft. alt., 28 May 1921, *Kirkwood 1222* (CAL); open ridges, mountains near Missoula, 4000 ft. alt., 30 May 1921, *Kirkwood 1222* (M); Flat-Head River, *Nuttall* (G, NY, cotypes).

IDAHO: near Sawtooth, ridge between Sawtooth and Alturas Lake, 7400–8500 ft. alt., 9–10 July 1896, *Evermann 526* (CH, US); near summit of Secesh Mt., 9000 ft. alt., 2 July 1895, *Henderson 3180* (US); fine gravel on top of peak, Josephus Lakes, Custer Co., 8000 ft. alt., 3 Aug. 1916, *Macbride & Payson 3548* (CAL, D, G, M, R, US); Payette Forest Reserve, 1912, *Mains 407* (R); Payette, 4000 ft. alt., 9 June 1911, *Moore 407* (R); Sawtooth National Forest, 1910, *Woods 4, 28a, 214* (R).

5. **A. Watsoni** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900; Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.]. Pl. 40, fig. 2.

Cymopterus glaucus Nutt. acc. to Wats. Bot. King's Exp. 124. 1871, not *C. glaucus* Nutt. Jour. Acad. Phila. **7**: 28. 1834.

C. Watsoni (Coult. & Rose) Jones, Contr. West. Bot. 12: 25. 1908.

Plants subcaulescent with the development of a conspicuous pseudoscape, 0.5–2.5 dm. high; leaves ovate-oblong in general outline, excluding the petiole, 3–8 cm. long, 2–4 cm. broad, scaberulent, tri–quadri-pinnatisect, ultimate segments linear, obtuse, mostly incurved, confluent, 1–2 mm. long, about 1 mm. broad, petiole 1.5–4 cm. long; mature peduncles exceeding the leaves, 6–14 cm. long, umbels several-rayed, rays spreading, 10–30 mm. long, involucre absent, involucel of several linear, acute bracts, about equalling the white flowers; fruit ovate to ovate-oblong in general outline, 4–6 mm. long, 3–6 mm. broad, wings short or well-developed, narrow at the base in cross-section, oil tubes 4 in the intervals, 8 on the commissure, seed face deeply concave.

Type specimen: *Watson 450,* Battle Mts., 7500 ft. alt., June 1868 (TYPE in the United States National Herbarium).

Distribution: northeastern Nevada from the Battle Mountains to the East Humboldt Mountains.

Specimens examined:

NEVADA: Sulphur Springs, west of Humboldt Mts., 20 May 1859, *H. Engelmann* (M); Austin, 16 June 1882, *M. E. Jones* (P82135 in part); Kanarrah, 4000 ft. alt., 21 April 1880, *M. E. Jones 1688* (CH, F, P, US); Palisade, 5000 ft. alt., 17 June 1903, *Stokes* (US 505390); Palisades, April 1880, *Vasey 229* (US); Battle Mts., 7500 ft. alt., June 1868, *Watson 450* (US TYPE); E. Humboldt Mts., 7000 ft. alt., July 1868, *Watson 450* (G).

6. A. aboriginum (Jones) Mathias, n. comb.

Pl. 25, fig. 37; pl. 43, fig. 2; pl. 45, fig. 1.

Cymopterus cinerarius Gray, Proc. Am. Acad. **6**: 535. 1865, in part; Brew. & Wats. Bot. Calif. **1**: 267. 1876, in part; Wats. Bibl. Ind. **1**: 418. 1878, in part; Coult. & Rose, Rev. N. Am. Umbell. 80. 1888, in part.

Aulospermum cinerarium (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 178. 1900, in part; Smiley, Univ. Calif. Publ. Bot. **9**: 282. 1921 [Fl. Sierra Nev. Calif.], in part.

Cymopterus aboriginum Jones, Contr. West. Bot. 12: 22, 27. 1908; Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 447. 1909.

C. aboriginum var. *ovalis* Jones, Contr. West. Bot. 12: 22. 1908; Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 447. 1909.

C. aboriginum var. *subternatus* Jones, Contr. West. Bot. 12: 23. 1908; Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 447. 1909.

C. aboriginum var. *oblongus* Jones, Contr. West. Bot. 12: 23. 1908; Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 447. 1909.

Plants acaulescent, 0.9–3.5 dm. high; leaves oblong in general outline, excluding the petiole, 3–10 cm. long, 1–4.5 cm. broad, glaucous, hirtellous, mostly quadripinnatisect, ultimate segments linear, acute, distinct or slightly confluent, 2–8 mm. long, 0.5–2 mm. broad, petiole 2–13 cm. long; peduncles glabrous, equalling or exceeding the leaves, 8–30 cm. long, umbels several-rayed, rays spreading, 4–20 mm. long, mostly glabrous, central umbellets sterile, involucre absent or present in the form of a few linear bracts, involucel of several linear, acute to acuminate, subscarious, more or less puberulent bracts, shorter than or equalling the white flowers; fruit ovate to oblong in general outline, 6–11 mm. long, 5–8 mm. broad, wings well-developed, linear in cross-section, oil tubes 2–8 in the intervals, 6–22 on the commissure; seed face slightly concave.

Type specimen: *M. E. Jones*, Indian Spring, Charleston Mts., Nevada, 4000 ft. alt., 7 May 1906 (TYPE in the Herbarium of Pomona College).

Distribution: eastern California in Owen's and Inyo Valleys and adjacent Nevada.

Specimens examined.

NEVADA: Indian Spring, Charleston Mts., 4000 ft. alt., 7 May 1906, *M. E. Jones* (P 82030 TYPE, 82028).

CALIFORNIA: Silver Cañon, near Laws, Inyo Valley, *K. Brandegee* (CAL 173210); top of volcanic hill, s. of Lake Mono, 9000 ft. alt., 1863, *Brewer 1825* (G); Pleasant Cañon, Panamint Mts., 6000 ft. alt., 6 May 1897, *M. E. Jones* (CAL 373410); Bishop, Owen's Valley, 5000 ft. alt., 15 May 1897, *M. E. Jones* (CAS 153443, CAL 303387, M, NY in part, P 82033, 82035, R 48928).

7. A. minimum Mathias, n. sp.[79] Pl. 25, fig. 35; pl. 41, fig. 2.

[79] **Aulospermum minimum** Mathias, nov. sp.—Planta acaula vel subcaula, 0.3–0.8 dm. alta, scabro-puberula; foliis ovato-oblongis, petiolis excludentibus, 1–3 cm.

Plants acaulescent or subcaulescent with the development of a short pseudoscape, 0.3–0.8 dm. high, scabrous-puberulent; leaves ovate-oblong in general outline, excluding the petiole, 1–3 cm. long, 1–2 cm. broad, mostly tripinnatisect, ultimate segments acute, incurved, more or less confluent, 1–3 mm. long, about 1 mm. broad, petiole 0.5–3 cm. long, purplish; peduncles equalling or exceeding the leaves, 3–6 cm. long, umbels few-rayed, rays unequal, 2–6 mm. long, involucre absent, involucel dimidiate, of several distinct, linear, acute, green or purplish bracts, equalling or exceeding the white flowers; fruit oblong in general outline, 4–5 mm. long, about 3 mm. broad, dorsal and lateral wings well-developed, somewhat enlarged at the base in cross-section, oil tubes 4–6 in the intervals, 4–6 on the commissure, occasionally 1 in the wing base, seed face slightly concave.

Type specimen: *Mathias 723*, on the upper part of the "Breaks," Cedar Breaks, near Cedar City, Iron Co., Utah, about 10,500 ft. alt., 19 July 1929 (TYPE in the Missouri Botanical Garden Herbarium).

Distribution: known only from the type locality.

Specimens examined:

UTAH: red sand, Cedar Breaks, about 10,000 ft. alt., 17 July 1930, *Goodman & Hitchcock 1591* (M); on the upper part of the "Breaks," Cedar Breaks, near Cedar City, Iron Co., about 10,500 ft. alt., 19 July 1929, *Mathias 723* (M TYPE); on the upper slopes, Cedar Breaks, Iron Co., about 10,000 ft. alt., 29 Sept. 1930, *Mathias 795*, (M, P).

8. **A. basalticum** (Jones) Tidestrom.[79a]

longis, 1–2 cm. latis, tripinnatisectis, ultimis segmentis foliorum acutis, subconfluentibus, 1–3 mm. longis, circa 1 mm. latis, petiolis 0.5–3 cm. longis, purpureis; pedunculis foliis aequis vel longioribus, 3–6 cm. longis, umbellis pauciradiatis, radiis 2–6 mm. longis, involucro nullo, involucellae bracteis pluribus, dimidiatis, linearis, acutis, viridibus vel purpureis, floribus albis aequis vel longioribus; fructibus oblongis, 4–5 mm. longis, circa 3 mm. latis, dorsalibus lateralibusque alis, subinflatis ad basim in sectione transverso, vittis 4–6 in intervallis, 4–6 in commissura, interdum 1 in ala, facieii seminis subconcava.—*Mathias 723*, on the upper part of the "Breaks," Cedar Breaks, near Cedar City, Iron Co., Utah, about 10,500 ft. alt., 19 July 1929 (TYPE in the Missouri Botanical Garden Herbarium).

[79a] See p. 399 for description.

9. **A. Rosei** Jones in Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 179. 1900; Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.]. Pl. 25, fig. 36; pl. 42, fig. 2.

Cymopterus Rosei Jones Contr. West. Bot. 12: 17, 27. 1908.

Coriophyllus Rosei (Jones) Rydb. Bull. Torr. Bot. Club **40**: 70. 1913; Fl. Rocky Mts. 620. 1917, and ed. 2. 620. 1922.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.7–1.5 dm. high; leaves ovate-oblong in general outline, excluding the petiole, 1–4.5 cm. long, 1.5–4.5 cm. broad, bi–tri-pinnatisect, primary divisions mostly remote, subcuneate, 1–2.5 cm. long, 2–2.5 cm. broad, ultimate segments more or less confluent, appearing as lobes of a cuneate leaflet, slightly roughened on the margins, petiole 1.5–5 cm. long, purplish; peduncles equalling or exceeding the leaves, 3–12 cm. long, more or less scaberulent, umbels several-rayed, rays spreading, unequal, 5–20 mm. long, more or less scaberulent, involucre absent, involucel of triangular to linear, acuminate, green or purplish bracts, about equalling the yellow or purple flowers; fruit ovate-oblong in general outline, 5-10 mm. long, 5–7 mm. broad, wings well-developed, not enlarged at the base in cross-section, oil-tubes 3–7 in the intervals, 4–7 on the commissure, seed face slightly to deeply concave.

Type specimen: *M. E. Jones 30*, Richfield, Utah, 18 June 1898 (TYPE in the United States National Herbarium).

Distribution: south-central Utah.

Specimens examined:

UTAH: Monroe, 12 May 1899, *M. E. Jones* (D 148728, P 82188); Richfield, Sevier Co., 5500 ft. alt., 18 June 1899, *M. E. Jones* (D 148727, P 82192); Vermilion, 4 June 1901, *M. E. Jones* (D 148726, P 82190); Gunnison, 5000 ft. alt., 18 April 1911, *M. E. Jones* (P 82258); Richfield, 18 June 1898, *M. E. Jones 30* (US TYPE); Elsinore, 13 June 1898, *M. E. Jones 31* (US); near the mouth of Salina Cañon, 5200–6000 ft. alt., 14 June 1894, *M. E. Jones 5422g* (US); Elsinore, Sevier Co., 5500 ft. alt., 13 June 1899, *M. E. Jones 6338* (D, M, P, US); dry alkaline slopes, Bryce Canyon, 8600 ft. alt., 18 July 1929, *Mathias 671* (M).

10. **A. duchesnense** (Jones) Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.]. Pl. 25, fig. 34; pl. 42 fig. 1.

Cymopterus duchesnensis Jones, Contr. West. Bot. 13: 12. 1910.

Plants acaulescent or subcaulescent with the development of an inconspicuous pseudoscape, 1–2.5 dm. high, glabrous; leaves broadly ovate-oblong in general outline, excluding the petiole, 3–9 cm. long, 3–6.5 cm. broad, bi–tri-pinnatisect, primary divisions remote, cuneate to obovate in general outline, secondary divisions subcuneate, the ultimate segments appearing as acute, mucronate lobes of a broad leaflet, petiole 3–10 cm. long; peduncles exceeding the leaves, 5–20 cm. long, umbels several-rayed, rays more or less spreading-erect, 20–45 mm. long, involucre absent, involucel of several conspicuous, distinct, linear bracts (sometimes reduced), usually exceeding the yellow flowers; fruit ovate-oblong in general outline, 8–10 mm. long, 5–8 mm. broad, wings conspicuous, not enlarged at the base in cross-section, oil tubes 3–7 in the intervals, 5–6 on the commissure, seed face slightly concave.

Type specimen: *M. E. Jones,* among loose rocks on southern slopes of mesas, Myton, Utah, 5000 ft. alt., 20 May 1908 (TYPE in the Herbarium of Pomona College, cotypes in the Rocky Mountain Herbarium of the University of Wyoming and the herbaria of the New York Botanical Garden and the California Academy of Sciences).

Distribution: known only from the type locality.

Specimens examined:

UTAH: Myton, 5000 ft. alt., 20 May 1908, *M. E. Jones* (P 78675 TYPE, 78678, CAS 139090, NY, R 113304).

11. A. purpureum (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 178. 1900; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 359. 1909; Clem. & Clem. Rocky Mt. Fl. 227. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 482. 1915 [Fl. New Mex.]; Tidestrom, Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.].

Cymopterus purpureus Wats. Am. Nat. **7**: 300. 1873; Bibl. Ind. **1**: 419. 1878; Coult. & Rose, Rev. N. Am. Umbell. 80. 1888; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 27. 1908.

Aulospermum Betheli Osterh. Muhlenbergia **6**: 46. 1910.

Coriophyllus purpureus (Wats.) Rydb. Bull. Torr. Bot. Club **40**: 70. 1913; Fl. Rocky Mts. 620. 1917, and ed. 2. 620. 1922.

Plants acaulescent or shortly subcaulescent, 1–5 dm. high, glabrous or sparsely scaberulent on the leaves and peduncle; leaves ovate to broadly ovate-oblong in general outline, excluding the petiole, 2–13.5 cm. long, 2–10 cm. broad, tri-quadri-pinnatisect, the primary divisions remote, ultimate segments distinct or slightly confluent, triangular, acute, mucronate, 1–5 mm. long, 1–4 mm. broad, petiole 3–12 cm. long; peduncles exceeding the leaves, 5–34 cm. long, umbels several-rayed, rays spreading, 10–90 mm. long, involucre absent, involucel dimidiate, of several, distinct, linear, acuminate bracts, shorter than the purple or greenish-yellow flowers; fruit oblong to ovate-oblong in general outline, 6–12 mm. long, 5–10 mm. broad, wings narrow or slightly enlarged at the base in cross-section, oil tubes 1–8 in the intervals, 3–11 on the commissure, seed face concave.

Type specimen: *E. Palmer*, New Mexico, 1869 (TYPE in the Gray Herbarium of Harvard University, cotypes in the United States National Herbarium).

Distribution: southwestern Colorado and northwestern New Mexico to southwestern Utah.

Specimens examined:

COLORADO: Cimarron, 6900 ft. alt., 6 June 1901, *C. F. Baker 18* (G, M, P, US); Ridgway, 25 June 1898, *Bethel 23* (US); Mancos, June 1891, *Eastwood* (US 55440); Durango, 10 June 1890, *Eastwood 7* (US); Durango, 10 June 1890, Mancos, 16 June 1890, *Eastwood 7* (US); Grand Junction, 18 May 1916, *Eastwood 5201* (D); Ft. Duchesne, 22 May 1908, *M. E. Jones* (P 78778); De Beque, Mesa Co., 19 May 1911, *Osterhout 4471* (P, R); dry hillsides, Naturita, 5500 ft. alt., 27 April 1914, *E. B. Payson 255* (D, F, G, M, MU, R); white shale hills, Ridgway, Ouray Co., 17 June 1924, *Payson & Payson 3827* (CAL, D, G, M, R); Ryser Creek, Mesa Gr., Delta Co., 6600 ft. alt., April 1892, *Purpus 97* (CH); Tongue Creek, Mesa Gr., Delta Co., 6200 ft. alt., June 1892, *Purpus 197* (CAL, CH); loose dirt near trail, Piedra, 21 June 1924, *Schmoll 1226* (R); Spruce Tree Camp, Mesa Verde National Park, 6969 ft. alt., 6 June 1925, *Schmoll 1690* (R);

lower oak region, west of Delta, 1800 m. alt., 6 June 1909, *Tidestrom 2167* (US).

New Mexico: Aztec, 5500 ft. alt., April 1899, *C. F. Baker 498* (F, G, M, N, P, R, US); Gallup, 14 June 1916, *Eastwood 5600* (G, US); Jacarilla Apache Indian Reservation, Stinking Lake, Rio Arriba Co., 2240–2300 m. alt., 20 April 1911, *Eggleston 6413* (US); Ft. Wingate, 27 May 1883, *Marsh* (US 55448); Ft. Wingate, 1883, *Matthews* (G); 1869, *E. Palmer* (G type, US 44313, 47083).

Utah: 1873, *Bishop* (F 34601, G); 1872, *Bishop 27* (US); clay hill, Wellington, Carbon Co., 4500 ft. alt., 5 June 1927, *Cottam 2039* (BYU); Cedar Canyon, Iron Co., 6500 ft. alt., 31 May 1929, *Cottam 3925* (BYU); mt. slopes, Pintura, Wash. Co., 4000 ft. alt., 22 April 1930, *Cottam 4647* (BYU, M); gravelly hills, La Verkin, Wash. Co., 3000 ft. alt., 23 April 1930, *Cottam 4744* (BYU, M); Price, 24 June 1898, *M. E. Jones* (US 55447); Price, 4900 ft. alt., 29 June 1898, *M. E. Jones* (D 148732); San Rafael Swell, 13 May 1914, *M. E. Jones* (D 148720, P 83102); La Sal Mts., 2 June 1914, *M. E. Jones* (P 83101); Silver Reef, 4500 ft. alt., 4 May 1894, *M. E. Jones 5163t* (US); Cedar City, 6000 ft. alt., 10 May 1894, *M. E. Jones 5204x* (US); cañon above Tropic, 6500 ft. alt., 28 May 1894, *M. E. Jones 5312s* (US); Emery, 7000 ft. alt., 16 June 1894, *M. E. Jones 5445i* (US); Mokiak Pass, 1877, *E. Palmer 177* (G, US); valley of the Virgin, near St. George, 1874, *Parry 84* (F, G, M, PA, PAR); Price, 20 June 1889, *Stokes* (CAL 174529); in clay, Price, 4700 ft. alt., 12 June 1900, *Stokes* (US 404282); Milford, 10 May 1903, *Stokes* (CAL 140620); Milford, 5500 ft. alt., 10–11 May 1903, *Stokes* (US 505625); Kanab, *Mrs. E. P. Thompson* (G); in cañon at Cedar City, 1510 m. alt., 11 May 1919, *Tidestrom 9416* (US).

Arizona: Buckskin Mts., 19 June 1890, *M. E. Jones* (D 148730); Navajo Spring, Buckskin Mts., 19 June 1890, *M. E. Jones* (D 148731); Pagumpa Spring, 4000 ft. alt., 20 April 1894, *M. E. Jones 5082r* (US); gravel, Pagumpa, 4000 ft. alt., 21 April 1894, *M. E. Jones 5092* (CAL, M, US); 1872, *Mrs. E. P. Thompson 11* (US).

12. A. Jonesii Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 178. 1900; Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.]. Pl. 22, fig. 11; pl. 44, fig. 1.

Cymopterus Jonesii Coult. & Rose, Rev. N. Am. Umbell. 80. 1888; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 27. 1908.

Coriophyllus Jonesii (Coult. & Rose) Rydb. Bull. Torr. Bot. Club **40**: 70. 1913; Fl. Rocky Mts. 620. 1917, and ed. 2. 620. 1922.

Plants acaulescent or rarely subcaulescent with the development of a short pseudoscape, 1–3 dm. high, glabrous; leaves ovate-oblong in general outline, excluding the petiole, 2–7 cm. long, 1.5–5 cm. broad, more or less glaucous, tri–quadri-pinnatisect, ultimate segments triangular, acute, mucronulate, distinct or slightly confluent, 1–5 mm. long, 1–2 mm. broad, petiole 2.5–10 cm. long; peduncles exceeding the leaves, 3–17 cm. long, umbels several-rayed, rays spreading, 8–35 mm. long, involucre absent, involucel dimidiate, of several triangular to linear, acuminate bracts, about equalling the purple flowers; fruit broadly ovate in general outline, 7–12 mm. long, 10–14 mm. broad, wings much elongated, conspicuously inflated at the base in cross-section, oil tubes solitary in the intervals, 2 on the commissure, seed face deeply concave.

Type specimen: *M. E. Jones 1808*; Frisco, Utah, 8000 ft. alt., 22 June 1880 (TYPE in the United States National Herbarium, cotypes in the Dudley Herbarium of Leland Stanford, Jr. University, and the herbaria of the University of Chicago, Pomona College, the Field Museum of Natural History, and the Missouri Botanical Garden).

Distribution: southwestern Utah in the region of the type locality.

Specimens examined:

UTAH: Cove Creek, 16 June 1898, *M. E. Jones* (US 55446, P 82185); Frisco, 8000 ft. alt. 22 June 1880, *M. E. Jones 1808* (US 46318 TYPE, CH 252512, D 125990, 148729, F 89012, M, P); 1874, *Parry 80* (G, PAR).

13. **A. panamintense** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 177. 1900. Pl. 25, fig. 33; pl. 44, fig. 2.

Cymopterus panamintensis Coult. & Rose, Contr. U. S. Nat. Herb. **4**: 116. 1893; Heller, Cat. N. Am. Pl. 96. 1898, and ed.

2. 151. 1900; Jones, Contr. West. Bot. 12: 27. 1908; Jeps. Man. Fl. Pl. Calif. 730. 1925.

Plants acaulescent, 0.5–4 dm. high, glabrous; leaves ovate-oblong to obovate in general outline, excluding the petiole, 1–14 cm. long, 1–8 cm. broad, tri–quadri-pinnatisect, ultimate segments linear, acute, somewhat spinulose, mostly distinct, 1–5 mm. long, about 1 mm. broad, petiole 1–10 cm. long; peduncles exceeding the leaves, 3–25 cm. long, umbels several-rayed, rays spreading, 10–65 mm. long, involucre absent, involucel dimidiate, of several conspicuous, linear, acuminate, more or less united bracts, equalling or exceeding the greenish-yellow flowers; fruit ovate-oblong in general outline, 6–10 mm. long, 3–8 mm. broad, wings conspicuous, somewhat enlarged at the base in cross-section, oil tubes 1–5 in the intervals, 4–7 on the commissure, seed-face slightly to deeply concave.

Type specimen: *Coville & Funston 508*, "near Pete's garden, in Johnson Canyon," Panamint Mountains, Inyo Co., 1740 m. alt., 30 March 1891 (TYPE in the United States National Herbarium, cotypes in the Herbarium of the University of Chicago).

Distribution: primarily in the Panamint and Argus Mountains of California.

Specimens examined:

California: dry hillsides, Bubbs Creek, Sierra Nevada Mts., 10,000 ft. alt., 1900, *S. W. Austin 514* (US); Panamint Mountains, Inyo Co., 1740 m. alt., 30 March 1891, *Coville & Funston 508* (US TYPE, CH); Panamint Mountains, Inyo Co., 2200 m. alt., 3 April 1891, *Coville & Funston 545* (G, M, MU, NY, PA, US); Shepherd Cañon, Argus Mountains, 800–2000 m. alt., 28 April 1891, *Coville & Funston 739* (US); Kane Spring, Ord Mts., San Bernardino Co., 1 May 1906, *Hall & Chandler 6805* (CAL); Shepherd Cañon, Argus Mts., Inyo Co., 3000 ft. alt., 17 May 1906, *Hall & Chandler 7061* (CAL, R); Shepherd's Cañon, 4700 ft. alt., 29 April 1897, *M. E. Jones* (CAL 303388, M, US 359183); Shepherd's Cañon, 4600 ft. alt., 30 April 1897, *M. E. Jones* (D 149820, NY, R 48916); rocky slopes, Argus Mts., 4000–5000 ft. alt., June 1897, *Purpus 5288* (CAL); rocky slopes, Argus Mts., 4000–5000 ft. alt., June 1897, *Purpus 5393* (CAL, G, M, US).

13a. A. panamintense var. **acutifolium** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 177. 1900. Pl. 25, fig. 32.

Leaf divisions more remote than in the species, ultimate segments acute, not conspicuously spinulose, 3–20 mm. long.

Type specimen: *Lemmon & Lemmon*, Newberry's Springs, Mojave Desert, California, May 1884 (TYPE in the United States National Herbarium, cotypes in the Herbarium of the University of California).

Distribution: Mohave Desert of southern California.

Specimens examined:

CALIFORNIA: Newberry, Mohave Desert, San Bernardino Co., May 1905, *H. M. Hall 6127* (CAL); Buzzard Rock, Barstow, Mohave Desert, 2800 ft. alt., 25 April 1921, *Jaeger 309* (US); Newberry's Spring, Mohave Desert, 10 May 1884, *J. G. Lemmon 3239* (CAL, G); Newberry's Spring, Mojave Desert, May 1884, *Lemmon & Lemmon* (US 44350 TYPE, CAL 334488, 335930); about rocks, high slope, Newberry Mts., east of Daggett, 6 April 1924, *Munz & Keck 7854* (G); Red Knob, Barstow, Mojave Desert, San Bernardino Co., 13 April 1919, *S. B. Parish 19235* (CAL); in crevices of rocks, dry hills of Mojave Desert, May 1882, *Parish & Parish 1294* (G).

This variety may prove to be a much attenuate form of the species. However, present collections would warrant its retention in varietal rank.

EXCLUDED SPECIES

A. cinerarium (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 178. 1900, in part = **Cymopterus cinerarius** Gray, emend. Mathias.

XII

PHELLOPTERUS Nutt.

Phellopterus Nutt. acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 166. 1900, not *Phellopterus* Benth. in Benth. & Hook. Gen. Pl. **1**: 905. 1867; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 356. 1909; Nels. Spring Fl. Intermt. States, 115. 1912; Britt. & Brown, Ill. Fl. ed. 2. **2**: 644. 1913; Clem. & Clem. Rocky Mt. Fl. 234. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 481. 1915 [Fl. New Mex.];

Rydb. Fl. Rocky Mts. 619. 1917, and ed. 2. 619. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 395. 1925 [Fl. Utah & Nev.].

Cymopterus § *Phellopterus* Nutt. in Torr. & Gray, Fl. N. Am. **1**: 623. 1840, excl. *C. glaucus* (Nutt.) Torr. & Gray.

Cymopterus § *Leptocnemia* Nutt. in Torr. & Gray, Fl. N. Am. **1**: 624. 1840.

Cymopteribus Buckl. Proc. Acad. Phila. **1861**: 455. 1862; Ind. Kew. **1**: 684. 1895; err. typ.

Low, herbaceous, acaulescent, or subcaulescent with the development of a pseudoscape, glabrous or somewhat roughened perennials. Leaves thin, submembranous, bi–tri-pinnatisect, ultimate leaf divisions narrow; petioles sheathing. Inflorescence somewhat globose, peduncles shorter than or exceeding the leaves; involucre, when present, of more or less united scarious bracts; involucel bracts scarious, large, conspicuous. Calyx teeth not persistent. Stylopodium lacking. Carpophore persistent, 2-parted. Fruit ovate-oblong, glabrous, flattened dorsally; lateral and dorsal wings present; oil tubes small, 1–9 in the intervals, 3–12 on the commissural side, accessory oil tubes occasionally present in the wing base; conspicuous strengthening cells absent; seed face slightly concave.

Type species: **Phellopterus montanus** Nutt. acc. to Torr. & Gray, Fl. N. Am. **1**: 624. 1840, in synonymy; acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 167. 1900.

KEY TO SPECIES

A. Mature peduncles shorter than or equalling the leaves; wings of the fruit conspicuously enlarged at the base in cross-section........*1. P. montanus*

AA. Mature peduncles equalling or exceeding the leaves; wings of the fruit not conspicuously enlarged at the base in cross-section.

B. Involucel bracts lacerate-fringed at the apex; plants of the Texas prairies..*2. P. macrorhizus*

BB. Involucel bracts entire or obtusely lobed; plants of the Rocky Mountain region and southern Great Basin.

C. Involucel bracts white or whitish, few-nerved.

D. Umbels more or less spreading, mature rays 10–50 mm. long; fruit ovate-oblong to oblong, wings mostly narrower than the body of the seed...............................*3. P. bulbosus*

DD. Umbels densely globose, mature rays 4–10 mm. long; fruit ovate, wings broader than the body of the seed........*4. P. purpurascens*

CC. Involucel bracts purple or greenish-white, conspicuously many-nerved.....................................*5. P. multinervatus*

1. **P. montanus** Nutt. acc. to Torr. & Gray, Fl. N. Am. **1**: 624. 1840, in synonymy; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 167. 1900; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 356. 1909; Nels. Spring Fl. Intermt. States, 115. 1912; Britt. & Brown, Ill. Fl. ed. 2. **2**: 645. 1913; Small, Fl. S. E. U. S. ed. 2. 874. 1914; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Rydb. Fl. Rocky Mts. 619. 1917, and ed. 2. 619. 1922. Pl. 22, fig. 7.

Cymopterus montanus (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 624. 1840; Walp. Rep. Bot. Syst. **2**: 418. 1843; Wats. Bibl. Ind. **1**: 418. 1878, excl. *C. macrorhizus* Buckl.; Coult. Man. Bot. Rocky Mt. 119. 1885; Tweedy, Fl. Yellowstone Nat. Park, 40. 1886; Coult. & Rose, Rev. N. Am. Umbell. 78. 1888; Webber, Cat. Fl. Nebr. 124. 1890; Nels. Fl. Wyo. 116. 1896; Rydb. Contr. U. S. Nat. Herb. **3**: 502. 1896 [Fl. Black Hills]; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Rydb. Mem. N. Y. Bot. Gard. **1**: 293. 1900; Britt. Man. 685. 1901, and ed. 2. 685. 1905; Jones, Contr. West. Bot. 12: 25. 1908.

C. campestris (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 624. 1840; Walp. Rep. Bot. Syst. **2**: 418. 1843; Wats. Bibl. Ind. **1**: 418. 1878; Coult. Man. Bot. Rocky Mt. 119. 1885; Coult. & Rose, Rev. N. Am. Umbell. 76. 1888; Heller, Cat. N. Am. Pl. 99. 1898, and ed. 2. 151. 1900.

"*C. montanus* Nutt. in Torr. & Gray" acc. to Gray, Mem. Am. Acad. N. S. **4**: 56. 1849 [Pl. Fendl.]; Smiths. Contr. **5**: 79. 1853 [Pl. Wright. **1**: 79. 1853]; Torr. Bot. Whipple's Exp. 36 [92]. 1857; Gray, Bot. Ives' Exp. 15. 1860, name only; Engelm. Trans. Am. Phil. Soc. N. S. **12**: 193. 1861 [Bot. Hayden Exp.]; Wats. Bot. King's Exp. 123. 1871; Port. & Coult. Syn. Fl. Col. 50. 1874; Brew. & Wats. Bot. Calif. **1**: 266. 1876.

Phellopterus macrocarpus Osterh. Muhlenbergia **6**: 59. 1910; Rydb. Fl. Rocky Mts. 619. 1917, and ed. 2. 619. 1922.

Phellopteris montana Nutt. acc. to Petersen, Fl. Nebr. 162. 1912, err. typ.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.5–3 dm. high, from long fusiform or subfusiform roots; leaves ovate-oblong in general outline, excluding the petiole, 1.5–8 cm. long, 1–6 cm. broad, bi–tri-pinnatisect, ulti-

mate segments confluent, mostly obtuse and mucronate, roughened on the margins and veins, 1–2 mm. long, 0.5–1 mm. broad; petioles 1–14 cm. long; peduncles shorter than or equalling the leaves, 0.5–10 cm. long, minutely roughened throughout or only at the base of the umbel; umbels subglobose, 5–10-rayed, rays 0.5–20 mm. long, glabrous or minutely hirtellous, secondary rays short; involucre absent or present as a low inconspicuous sheath or composed of conspicuous linear-oblong bracts, involucel bracts conspicuous, ovate-oblong, mostly acute, sometimes lacerate towards the apex, white with a conspicuous green central nerve, mostly shorter than the white or purple flowers; fruit ovate to ovate-oblong, 5–12 mm. long, 4–10 mm. broad, wings in cross-section conspicuously enlarged at the base and narrowed toward the apex, oil tubes 1–4 in the intervals, 3–6 on the commissure, accessory oil tubes occasionally present in the wings, strengthening cells absent or present in the wing base.

Type specimen: *Nuttall*, "high bare plains of the Platte, towards the Rocky Mountains" (TYPE in the Herbarium of the Academy of Natural Sciences, Philadelphia).

Distribution: southern South Dakota to northern Oklahoma, central Kansas to central Colorado.

Specimens examined:

SOUTH DAKOTA: Black Hills, 1887, *Forwood* (G); Fort Meade, 2 May 1887, *Forwood 147* (M); Fort Pierre to Bad Lands, 15 April 1855, *Hayden* (M); Fort Pierre to Bad Lands, 20 April 1855, *Hayden 4* (M); clay flats, Interior, Stanley Co., 7 May 1914, *Over 6205* (US); Hot Springs, 3500 ft. alt., 14 June 1892, *Rydberg 726* (US).

NEBRASKA: Gordon, 26 April 1891, *Bates* (G); Alliance, 16 May 1914, *Bates 5895* (MU); prairies, Phelps Co., 8 June 1889, *Bodin* (MU 163441); prairies, Trenton, 1 April 1899, *W. L. French* (M); Minden, 3 May 1913, *Hapeman* (M 852144); door yard, Deuel Co., 27 June 1891, *Rydberg 130* (US).

KANSAS: Greeley Co., 1910, *J. P. Anderson* (IAC 74572); Dodge City, April 1891, *Ellis* (M in part); Atwood, 18 April 1891, *Fry* (US 228673); stony hills, Logan Co., 9 May 1895, *A. S. Hitchcock 191* in part (G); Ellis, April 1877, *Watson* (G); Spearville, Ford Co., April 1886, *Wentz* (US 55442).

OKLAHOMA: hilltop near Buffalo, Harper Co., 4 May 1913, *Stevens 300* (G).

WYOMING: Cooper Lake, Albany Co., 17 June 1901, *Goodding* (R 37161); Laramie, May 1893, *A. Nelson* (R); dry ground, Laramie, 13 May 1903, *A. Nelson 2* (NEV); Laramie Plains, 30 May 1893, *A. Nelson 8* (US); Laramie, 7 May 1894, *A. Nelson 9* (CAS, F, G, M, MU, US); Laramie, 30 May 1893, *A. Nelson 1400* (R); Pine Bluff, 15 May 1897, *A. Nelson 2891* (R); Laramie Plains, 7 May 1894, *A. Nelson 3806* (*9*) (R); sandy plains, Sand Creek, Albany Co., 2 June 1900, *A. Nelson 7022* (G, M, R, US); dry sandy bottoms, Wendover, Laramie Co., April 1902, *A. Nelson 8845* (R); sandy soil, Laramie, 25 May 1910, *A. Nelson 9330* (R); Laramie, 24 May 1899, *E. Nelson 185* (G); Platte Plains, R. Mts., *Nuttall* (PA TYPE); in places inundated in winter, R. Mts., *Nuttall* (G, NY); *Parry 31* (PAR); Little Sandy, 1873, *Parry 117* (F, PAR); Green River, 1873, *Parry 117* (G); Little Sandy, June 1873, *Parry 117* (*42*) (PAR); Fort D. Russell, 1 May 1885, *Ruby* (US 55430); Orin Junction, 6 June 1893, *Schneck* (M); E. of Laramie, 19 May 1897, *R. A. Smith 58* (M).

COLORADO: Fort Collins, 10–20 May 1895, *C. F. Baker* (P 100191); Fort Collins, 5000 ft. alt., 20 May 1896, *C. F. Baker* (F 412033, M, N 16763); plains, Larimer Co., 5000 ft. alt., 28 March 1895, *C. F. Baker* (*Patterson 3937*) (R); plains, Larimer Co., 18 April 1895, *C. F. Baker* (*Patterson 3937*) (M); Larimer Co., 5000 ft. alt., 6 May 1895, *C. F. Baker* (*Patterson 3937*) (G); Denver, May 1894, *Bethel* (F 91830); Denver, 25 June 1898, *Bethel* (US 329879); plains, Denver, 5000 ft. alt., May 1895, *Bethel 36–3* (US); Fremont Co., 1874, *T. S. Brandegee* (M); near Cañon City, May 1877, *T. S. Brandegee* (CAL 174092); Cañon City, Fremont Co., 1871, *T. S. Brandegee 43* (CAL); Cañon City, 1871, *T. S. Brandegee B43* (M); Cañon City, 1872, *T. S. Brandegee B44* in part (CAL); Fort Collins, 5000 ft. alt., 17 May 1895, *Crandall* (CAL 106588); Fort Collins, 3, 17 May 1896, *Crandall 32* (US); Denver, 1891, *Eastwood* (US 55441); plains near Greeley, May 1872, *Greene* (N); plains, Golden City, &c., 20 April 1870, *Greene 137* (G); American Plains Flora, Lat. 41°, 1862, *Hall & Harbour 211* (F, G, M); Pueblo, 8 June 1890, *Hicks & Hicks* (US 55427); near Denver, 5000 ft. alt., 25 May–

10 June 1896, *Holzinger 5* (US); vacant lot north of city park, Pueblo, 13 June 1917, *E. L. Johnston 549* (G); plains, Colorado Springs, 8 May 1878, *M. E. Jones 30* (F); New Windsor, May 1895, *Osterhout* (US 223476); New Windsor, 20 May 1897, *Osterhout* (F 432541); Las Animas, Bent Co., 18 June 1909, 16 May 1910, *Osterhout 3906B* (P); Fort Lyon, 9 April 1863, *E. Palmer* (US 55455); headwaters of Clear Creek, and the alpine ridges lying east of "Middle Park," 1861, *Parry 160* (G); plains east of Denver, Arapahoe Co., 11 May 1912, *Vestal 353* (D).

New Mexico: headwaters of the Canadian, April 1848, *Gordon* (M); Raton Valley, 6600 ft. alt., April 1897, *Mrs O. St. John* (G).

2. **P. macrorhizus** (Buckl.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 167. 1900; Small, Fl. S. E. U. S. ed. 2. 874. 1913; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 481. 1915 [Fl. New Mex.], name only. Pl. 22, fig. 8.

C[ymopteribus] macrorhizus Buckl. Proc. Acad. Phila. **1861**: 455. 1862, err. typ.

Cymopterus montanus var. *pedunculatus* Jones, Proc. Calif. Acad. Sci. II, **5**: 686. 1895; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 25. 1908.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.5–2.5 dm. high, from fusiform to subglobose roots; leaves ovate-oblong in general outline, excluding the petiole, 1.5–6.5 cm. long, 1–3 cm. broad, bipinnatisect, ultimate segments confluent, mostly obtuse and mucronate, sometimes minutely roughened on the margins, 1–3 mm. long, 1–2 mm. broad; petioles 1.5–3 cm. long; peduncles longer than the leaves, 2.5–17 cm. long, usually minutely roughened at the base of the umbel, umbels 6–12-rayed, rays 0.5–3 cm. long, glabrous or slightly roughened, the inner umbellets usually subsessile and sterile, secondary rays 5–10 mm. long, inner flowers sessile and sterile, involucre absent or present in the form of one or more linear bracts, involucel bracts conspicuous, subcuneate, lacerate-fringed at the apex, white with a dark central nerve, mostly shorter than the pinkish flowers; fruit ovate to ovate-oblong, 4–9 mm. long, 3–8 mm. broad, wings linear in cross-section, oil tubes 3–8 in the

intervals, 4–10 on the commissure, accessory oil tubes occasionally present in the wing base.

Type specimen: *Buckley*, "Prairies north of Austin," Texas, March 1860 (TYPE in the Herbarium of the Academy of Natural Sciences, Philadelphia).

Distribution: central Texas.

Specimens examined:

TEXAS: prairies north of Austin, March 1860, *Buckley* (PA TYPE); common on prairie, Dallas, 15 April 1900, *Bush 610* (M); Fort Belknap, Young Co., *Hayes 309* (F, US); *Kellerman* (CH 368633); Dublin, 1893, *Maxwell 15* (CH); valley of the Rio Grande below Doñana, *Mexican Boundary Survey 417* (US); dry calcareous open hillsides, Blanco, Blanco Co., 5 April 1918, *E. J. Palmer 13269* (M); Dallas, March 1874, *Reverchon* (G); dry uplands, Dallas, March 1876, *Reverchon* (F 90100); Dallas, March 1900, *Reverchon* (CAS 41393, F 185922, 324300, G, M, NEV 11575, 12721, R 72171, US 364681, 364682); calcareous rocky bluffs, west Dallas, 1 March, 10 April 1900, *Reverchon 360* (M); common on prairie, Dallas, 15 April 1900, *Reverchon 610* (M); rocky prairies, Dallas, March 1900, *Reverchon 2008* (G, M, US); limestone bluffs, Dallas, March 1900, *Reverchon 2008* (M, US); rocky prairies, Dallas, 10 April 1900, *Reverchon 2008a* (G, M, US); sandy soils, Ewin's Mts., west of San Angelo, 20 May 1903, *Reverchon 3564* (M, US); rocky prairies, Dallas, March, April, *Reverchon* (*Curtis 1031*) (F, G, M, US); dry hills in the vicinity of Big Spring, 23 Febr. 1910, *Rose, Standley & Russell 12203* (US); vicinity of Fort Worth, in valley of Trinity, 23 Febr.–10 April 1913, *Ruth 2* (M); rocky grounds, valley of Trinity, Tarrant Co., 23 Febr.–30 March 1914, *Ruth 2* (P, US); in open waste, rocky grounds, Tarrant Co., 23 Febr.–10 March 1920, *Ruth 2* (F); on rocky hills, Tarrant Co., 7 March–2 April 1920, *Ruth 2* (C); Tarrant Co., 15 Febr. 1923, *Ruth 2* (G); Dallas, 1873, *Woolson 96* (US); hills near Austin, March 1849, *Wright 233* (G, M).

3. P. bulbosus (Nels.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 168. 1900; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 357. 1909; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Rydb. Fl. Rocky Mts. 619. 1917, and ed. 2. 619. 1922. Pl. 31.

Cymopterus utahensis var. *Eastwoodae* Jones, Proc. Calif. Acad. Sci. II, **5**: 685. 1895; Heller, Cat. N. Am. Pl. 97. 1898, and ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 25. 1908.

C. bulbosus Nels. Bull. Torr. Bot. Club **26**: 241. 1899; Heller, Cat. N. Am. Pl. ed. 2. 151. 1900.

Phellopterus purpurascens (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 168. 1900, in part.

P. purpurascens var. *Eastwoodae* (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 169. 1900; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 357. 1909.

P. camporum Rydb. Bull. Torr. Bot. Club **31**: 574. 1904; Fl. Col. 254. 1906; Fl. Rocky Mts. 619. 1917, and ed. 2. 619. 1922.

P. utahensis (Jones) Wooton & Standl. Contr. U. S. Nat. Herb. **16**: 158. 1913, in part; Contr. U. S. Nat. Herb. **19**: 481. 1915 [Fl. New Mex.], in part; Rydb. Fl. Rocky Mts. 619. 1917, in part, and ed. 2. 619. 1922, in part; Tidestrom, Contr. U. S. Nat. Herb. **25**: 396. 1925 [Fl. Utah & Nev.], in part.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.5–3.5 dm. high, from long slender to clavate taproots, glabrous; leaves ovate-oblong in general outline, excluding the petiole, 1–9 cm. long, 0.6–7 cm. broad, bi–tri-pinnatisect, ultimate segments more or less confluent, linear, rounded to acute, 1–10 mm. long, 1–5 mm. broad; petioles 1.5–9 cm. long; peduncles usually several, mostly exceeding the leaves, 1.5–26 cm. long, umbels more or less spreading, several-rayed, rays 5–50 mm. long, secondary rays short, involucre conspicuous, varying from a low sheath to conspicuous connate, whitish, 1–3-nerved bracts, involucel similar to the involucre, equalling or exceeding the purplish flowers; fruit ovate-oblong to oblong, 7–17 mm. long, 4–12 mm. broad, wings mostly narrower than the body of the seed, in cross-section narrow or slightly enlarged at the base, acute, oil tubes 1–9 in the intervals, 3–10 on the commissure.

Type specimen: *A. Nelson 4709*, Green River, Wyoming, 14 June 1898 (TYPE in the Rocky Mountain Herbarium of the University of Wyoming, cotypes in the herbaria of the Missouri Botanical Garden and United States National Museum).

Distribution: southwestern Wyoming to central New Mexico, then east to western Texas and north to south-central Colorado.

Specimens examined:

TEXAS: Lubbock, 19 April 1926, *Studhalter 1116* (US).

WYOMING: on a red table land, Point of Rocks, Sweetwater Co., 1 June 1895, *A. Nelson 3085* (R, US); Green River, 14 June 1898, *A. Nelson 4709* (R TYPE, M, US); Kemmerer, Uinta Co., May 1907, *A. Nelson 9004* (R); Little Sandy, 1873, *Parry* (G); alkali flat, plains between Eden and Big Piney, Sublette Co., 6 July 1922, *Payson & Payson 2579* (F, M, R, US); Green River, 25 June 1895, *Shear 4382* (US); La Barge, Uinta Co., 27 April 1894, *Stevenson 40* (US).

COLORADO: Cerro Summit, 8000 ft. alt., 7 June 1901, *C. F. Baker 59* (G, M, N, P, R, US, WSC); Hermosa, 6700 ft. alt., April 1899, *C. F. Baker 500* (F, G, M, N, P, R, US); Gunnison, 27 June 1898, *Bethel 22* (US); Westcliffe, April–May 1888, *T. D. A. Cockerell* (CH 352965); Durango, La Plata Co., 3 June 1890, *Eastwood* (US 42496); Grand Junction, May 1892, *Eastwood* (CAL 172655); Grand Junction, Gunnison Mesa, 15 May 1916, *Eastwood 5120* (CAS); Durango, 21 May 1916, *Eastwood 5298* (CAS); Sapinero, 3 June 1884, *M. E. Jones* (CAL 303411, CAS 139321, P 84476); De Beque, Mesa Co., 19 May 1911, *Osterhout 4476* (P); Montrose, *E. B. Payson 29* (R); adobe flat, Montrose, 5800 ft. alt., 7 April 1914, *E. B. Payson 223* (F, G, R); dry hillside, Naturita, 5400 ft. alt., 22 April 1914, *E. B. Payson 244* (F, G, M, R); Surface Creek, Delta Co., 6000 ft. alt., April–May 1892, *Purpus 46* (CH); mesas near Pueblo, 1500–1600 m. alt., 15 May 1900, *Rydberg & Vreeland 5822* (R); mesas near Colorado Springs, 1800–2000 m. alt., 9 May 1900, *Rydberg & Vreeland 5823* (R, US); mesas near Pueblo, 1500–1600 m. alt., 14 May 1900, *Rydberg & Vreeland 5824, 5825* (US); among greasewood, Montrose, 1740 m. alt., 28 May 1909, *Tidestrom 2127* (US); on mesa near Ridgway, 2100 m. alt., 29 May 1909, *Tidestrom 2132* (US); on rocky slopes, Horse Fly Mt. region, 2400 m. alt., 31 May 1909, *Tidestrom 2148* (US); on mesa, near Delta, 1500 m. alt., 9 June 1909, *Tidestrom 2196* (US); damp level places among hills, Sapinero, 1898, *Wheeler 936* (R).

NEW MEXICO: road n. w. 3 m. from Las Vegas, 1980 m. alt., 5 April 1927, *Arsène 17989* (US); Aztec, 5500 ft. alt., April 1899, *C. F. Baker 499* (F, G, M, N, P, R, US); Gallup, 14 June 1916,

Eastwood 5654 (CAS); El Vado Road fourteen miles below Tierra Amarilla, 2120 m. alt., 21, 22 April 1911, *Eggleston 6432* (US); mesa on Park View Road, Tierra Amarilla, Rio Arriba Co., 2250 m. alt., 18 April–25 May 1911, *Eggleston 6488* (US); hills southwest of Tierra Amarilla, Rio Arriba Co., 2300 m. alt., 18 April–25 May 1911, *Eggleston 6501* (US); grassy flat, eastern side of Las Palamos, Sandia Mountains, 20 March, *Ellis 227* (US); near Madera, Sandia Mountains, *Ellis 227* (US); 1847, *Fendler 275* (G, M); Nara Visa, 17 April 1911, *Fisher 109* (US); Barranca, Taos Co., 6900 ft. alt., 26 May 1897, *Heller & Heller 3590* (M, US); Ft. Wingate, 29 May 1883, *Marsh* (US 55449); 1869, *E. Palmer* (G); Colfax Co., 1897, *Mrs. O. St. John* (G).

Utah: Wasatch Valley, 1878, *Brendel 232* (M); Cisco, 2 May 1890, *M. E. Jones* (G); Echo, 7 May 1890, *M. E. Jones* (CAL 174505); Green River, 9 May 1890, *M. E. Jones* (CAS 139089, 153731, M, R 113305); Westwater, 6 May 1891, *M. E. Jones* (R 26719); *Kleeberger 187* (CAS); 1869, *E. Palmer* (US 55453); E. side of Llano Estacado, April, *Pope* (G).

Arizona: X Ranch, 18 miles north of Holbrook, 21 May 1901, *W. Hough 103* (US); Oryabe, April–May 1858, *Newberry* (G in part, US 227485 in part); Totona, *Voth* (F 143490); *Voth 85* (F in part).

4. P. purpurascens (Gray) Coult. & Rose, emend.

Cymopterus montanus var. *purpurascens* Gray, Bot. Ives' Exp. 15. 1860; Brew. & Wats. Bot. Calif. **1**: 267. 1876; Wats. Bibl. Ind. **1**: 418. 1878; Coult. & Rose, Rev. N. Am. Umbell. 78. 1888; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900.

C. montanus var. *globosus* Wats. Bot. King's Exp. 124. 1871, as to fruit.

C. purpurascens (Gray) Jones, Zoe **4**: 277. 1893, not Proc. Calif. Acad. Sci. II, **5**: 687. 1895.

C. utahensis Jones, Proc. Calif. Acad. Sci. II, **5**: 684. 1895; Heller, Cat. N. Am. Pl. 96. 1898, and ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 25. 1908; Jeps. Man. Fl. Pl. Calif. 730. 1925.

C. utahensis var. *monocephalus* Jones, Proc. Calif. Acad. Sci.

II, **5**: 685. 1895; Heller, Cat. N. Am. Pl. 97. 1898, and ed. 2. 151. 1900; Jones, Contr. West. Bot. 12: 25. 1908, excl. *C. bulbosus* Nels.

Phellopterus purpurascens (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 168. 1900, in part; Rydb. Fl. Col. 254. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 357. 1909; Nels. Spring Fl. Intermt. States, 116. 1912; Clem. & Clem. Rocky Mt. Fl. 235. 1914.

P. utahensis (Jones) Wooton & Standl. Contr. U. S. Nat. Herb. **16**: 158. 1913, in part; Contr. U. S. Nat. Herb. **19**: 481. 1915 [Fl. New Mex.], in part; Rydb. Fl. Rocky Mts. 619. 1917, in part, and ed. 2. 619. 1922, in part; Tidestrom, Contr. U. S. Nat. Herb. **25**: 396. 1925 [Fl. Utah & Nev.], in part.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.3–1.5 dm. high, from long more or less slender tap-roots crowned with persistent leaf bases, glabrous; leaves ovate-oblong in general outline, excluding the petiole, 1.2–5 cm. long, 1–4 cm. broad, mostly tripinnatisect, ultimate segments confluent, rounded to acute, mostly incurved, 1–2 mm. long, about 1 mm. broad; petioles 1–4 cm. long; peduncles solitary or few, equalling or exceeding the leaves, 1.5–7 cm. long, umbels densely globose, rays 4–10 mm. long, secondary rays short, involucre of conspicuous white bracts, mostly connate below the middle, sometimes lobed at the apex, 1–5-nerved, involucel bracts conspicuous, similar to the involucre bracts, mostly rounded, white with 1–5 conspicuous green or white nerves, equalling or exceeding the purplish flowers; fruit mostly broadly ovate in general outline, 8–18 mm. long, 8–16 mm. broad, wings thin, as broad or broader than the body of the seed, in cross-section narrow or slightly enlarged at the base, acute, oil tubes 3–4 in the intervals, 4–7 on the commissure.

Type specimen: *Newberry*, "Oryabe, N. Mex." [Yampai Valley to San Francisco Mountains], Arizona, 28 March 1858 (TYPE in the United States National Herbarium, cotype in the Gray Herbarium of Harvard University).

Distribution: from southern Idaho south through Utah and Nevada to central Arizona.

Specimens examined:

IDAHO: near Pocatello, 20 May 1893, *E. Palmer 11* (US).

UTAH: from Filmore City to Santa Clara, May 1859, *Brewer* (M); Ferron, Carbon Co., 23 May 1928, *Cottam 1055* (BYU); on the hills near Camp Floyd, 5 April 1859, *H. Engelmann* (M); steep hillsides, Beaver Dam Wash, 18 March 1905, *Goodding 2150* (M, R); Tooele, 1 April 1887, *M. E. Jones* (P 83476); Terminus, May–June 1890, *M. E. Jones* (M, US 55443); Spanish Fork, 4500 ft. alt., 16 April 1896, *M. E. Jones* (US 359184); Spring Glen, Emery Co., 5500 ft. alt., 7 May 1896, *M. E. Jones* (R 113306); Marysvale, 1 April 1899, *M. E. Jones* (US 55444); Leamington, 5000 ft. alt., 8 May 1911, *M. E. Jones* (D 148687); Fillmore, 5000 ft. alt., 28 April 1880, *M. E. Jones 1685* (CH); Beaver Mts., 5500 ft. alt., 10–11 May 1903, *Stokes* (US 505628); Grass Valley, 6800–7000 ft. alt., 12 May 1875, *Ward 25* (F, M, US).

NEVADA: Aurum, 4 May 1893, *M. E. Jones* (CAS 139088); Warm Springs, White Pine Co., April 1918, *King* (CAS 41402); Mount Sabb, Palmetto Range, 9000–10,000 ft. alt., May–Oct. 1898, *Purpus 5866* (CAL, US); Candelaria, April 1886, *Shockley* (US 55421); Candelaria, 6500 ft. alt., March–April 1882, *Shockley 208* (G); Trinity Mts., 6000 ft. alt., May 1868, *Watson 449b* (US).

ARIZONA: near El Tovar, Grand Canyon of the Colorado River, April 1917, *Eastwood 6112* (CAS); grade above Pagumpa, 5000 ft. alt., 23 April 1894, *M. E. Jones 5098* (US); ten miles south of Black Rock Spring, 4500 ft. alt., 23 April 1894, *M. E. Jones 5098h* (US); Black Rock Spring, 4500 ft. alt., 23 April 1894, *M. E. Jones 5098p* (US); Petrified Forest, 9 May 1917, *Meiere* (CAS 41398); Oryabe [Yampai Valley to San Francisco Mountains], April–May 1858 [28 March 1858], *Newberry* (US 227485 in part, TYPE, G); Peach Springs, 3 April 1893, *Wilson 188* (N, P).

5. P. multinervatus Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 169. 1900; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 357. 1909; Nels. Spring Fl. Intermt. States, 116. 1912; Clem. & Clem. Rocky Mt. Fl. 235. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 481. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 619. 1917, and ed. 2. 619. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 396. 1925 [Fl. Utah & Nev.].

Pl. 30, fig. 2.

Cymopterus purpurascens Jones, Proc. Calif. Acad. Sci. II, **5**: 687. 1895, excl. synonym of Gray, not *C. purpurascens* (Gray) Jones, Zoe **4**: 277. 1893; Contr. West. Bot. 12: 25. 1908.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.4–2 dm. high, from long, slender or subfusiform tap-roots; leaves ovate-oblong in general outline, excluding the petiole, 1–8.5 cm. long, 0.5–6 cm. broad, bi-tri-pinnatisect, ultimate segments mostly confluent, acute or obtuse, mucronulate, glabrate, 0.5–6 mm. long, 0.5–2 mm. broad; petioles 2–7 cm. long; mature peduncles equalling or exceeding the leaves, 2–14 cm. long, glabrous, umbels somewhat spreading to globose, 5–12-rayed, rays 5–25 mm. long, glabrous, inner rays shorter and the umbellets usually sterile, secondary rays short, involucre a low scarious sheath or of one or two conspicuous nerved bracts or a conspicuous, purplish, connate cup with irregular many-nerved lobes, involucel of conspicuous ovate to ovate-oblong subconnate bracts, many-nerved, greenish or purple, usually with a whitish margin, about equalling the purplish flowers; fruit ovate to ovate-oblong, 8–17 mm. long, 8–17 mm. broad, frequently purplish-tinged, wings in cross-section long and slender, slightly enlarged at the base, oil tubes 3–9 in the intervals, 5–12 on the commissure, accessory oil tubes occasionally present in the wings, strengthening cells absent or present in the wing base.

Type specimen: *Lemmon & Lemmon*, Peach Springs, Arizona, May 1884 (TYPE in the United States National Herbarium, cotype in the Herbarium of the University of California).

Distribution: southern Utah to northern Mexico, southwestern New Mexico and adjacent Texas west to southeastern California.

Specimens examined:

TEXAS: 1851, *Thurber* (F 306482); Hueco Mts., March 1851, *Thurber 143* (G).

NEW MEXICO: Lake Valley, 1915, *Beals* (US 890489); Silver City, 18 April 1915, *Carlson* (CAS 41404); Silver City, 31 March, May 1919, *Eastwood 8188* (CAS, G, M, US); near Silver City, 14 April 1880, *Greene* (F 339); near Silver City, 15 April 1880, *Greene 11* (G); Lordsburg, 9 April 1930, *M. E. Jones 24678* (J); East of Lordsburg, 5 May 1930, *M. E. Jones 24679* (J); Rodeo, 8 April 1930, *M. E. Jones 24680* (J); Carrizallilo Mts., 17 April

1892, *Mearns 38* (US); Mangas Springs, 18 miles northwest of Silver City, Grant Co., 4770 ft. alt., 7 April 1903, *Metcalfe 3* (CAL, G, N, NEV, P, R, US); in the valley of the Rio Grande, below Doñana, *Mexican Boundary Survey* (US 55414); Santa Lucia Valley and —— Cañon, 1880, *Rusby* (G); Mangus Springs, 1880, *Rusby* (US 55435); dry hills, Mangus Springs, 28 Febr. 1880, *Rusby 147* (F); dry places, Mangus Springs, May 1880, *Rusby 147* (CAL, M).

Utah: 1872, *Bishop 29* (US); near Belleam, 3700 ft. alt., 30 March 1894, *M. E. Jones 5002* (US); in red clay, Harrisburg, 2800–3000 ft. alt., 30 March 1894, *M. E. Jones 5002* (CAL, G, M, R, US); Washington, 3000 ft. alt., 1 May 1894, *M. E. Jones 5140c* (US); Harrisburg, 3000 ft. alt., 2 May 1894, *M. E. Jones 5140c* (US); La Verkin, 3400–3700 ft. alt., 7–8 May 1894, *M. E. Jones 5169m* (US); Kanab, *Mrs. E. P. Thompson* (G); —— Mts., 1872, *W. Thompson* (US 55457).

Arizona: Prescott, 22 May 1919, *Eastwood 8836* (CAS); Fort Huachuca, 1895, *Ebert* (US 249106); Andrade, 13 March–23 April 1903, *Griffiths 4106* (US); Kingman, 3000 ft. alt., 16 April 1903, *M. E. Jones* (M, US 856828); Hualapai Mts., 4000 ft. alt., 23 April 1903, *M. E. Jones* (CAS 139087); Hackberry, 3800 ft. alt., 25 April 1903, *M. E. Jones* (R 113308); Peach Springs, May 1884, *J. G. Lemmon* (CAL 337397); *J. G. Lemmon 22* (CAL); Peach Springs, May 1884, *Lemmon & Lemmon* (US 55432 TYPE, CAL 193742); June 1891, *MacDougal 150* (US); Fort Apache, 1903, *Mayerhoff 134* (F); San Francisco Mt., 1858, *Newberry* (G); 1876, *E. Palmer* (G); Prescott, 20 April 1876, *E. Palmer 158* (M); sand hills in the vicinity of Benson, 2 March 1910, *Rose, Standley & Russell 12320* (US); Salt River Valley, 1891, *Toumey* (CH 375265); Jerome, May 1909, *Treakle* (P 83475); Peach Springs, April 1893, *Wilson* (R 62265).

Sonora: San Bernardino, March 1852, *Parry* (PAR).

California: on dry slope of San B. Mts., Cushenberry Spring, Mojave region, May 1882, *Parish & Parish 1293* (G).

EXCLUDED SPECIES

"*P. glaucus* Nutt. in Torr. & Gray, Fl. N. Am. **1**: 624. 1840" acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900 =

Aulospermum glaucum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900.

P. littoralis (Gray) Benth. in Benth. & Hook. Gen. Pl. **1**: 905. 1867, in part = **Glehnia littoralis** Schmidt, Miq. Ann. Mus. Bot. Lugd. Bat. **3**: 61. 1867.

P. littoralis (Gray) Benth. in Benth. & Hook. Gen. Pl. **1**: 905. 1867, in part = **Glehnia leiocarpa** Mathias, Ann. Mo. Bot. Gard. **15**: 95. 1928.

"*P. littoralis* Schmidt" acc. to Franchet & Savatier, Enum. Pl. Jap. 1: 85. 1875 = **Glehnia littoralis** Schmidt, Miq. Ann. Mus. Bot. Lugd. Bat. **3**: 61. 1867.

"*P. littoralis* Schmidt" acc. to Wats. Bibl. Ind. **1**: 430. 1878 = **Glehnia leiocarpa** Mathias, Ann. Mo. Bot. Gard. **15**: 95. 1928.

P. Jonesii (Coult. & Rose) Rydb. Fl. Rocky Mts. 627, 1064. 1917 = **Cymopterus Coulteri** (Jones) Mathias, new comb.

XIII

GLEHNIA Schmidt

Glehnia Schmidt, Prol. Fl. Jap. in Miq. Ann. Mus. Bot. Lugd. Bat. **3**: 61. 1867.

The type species is **Glehnia littoralis** Schmidt, Prol. Fl. Jap. in Miq. Ann. Mus. Bot. Lugd. Bat. **3**: 61. 1867; Prol. Fl. Jap. 249. 1867.

A complete review of this genus has been given in a previous paper.[80]

XIV

CYMOPTERUS

Cymopterus Raf. Jour. Phys. **89**: 100. 1819; DC. Mem. Fam. Omb. 57. 1829 [Coll. Mem. Hist. Regn. Veg. 5]; Prodr. **4**: 203. 1830; Raf. in Seringe, Bull. Bot. **1**: 216. 1830; Nutt. Jour. Acad. Phila. **7**: 28. 1834, as to generic description; Torr. & Gray, Fl. N. Am. **1**: 623. 1840, as to § *Eucymopterus;* Steud. Nom. Bot. ed. 2. **1**: 461. 1840; Endl. Gen. Pl. 784, n. 4491. 1836–1840; Meisner, Pl. Vasc. Gen. **1**: 148; **2**: 107. 1836–40; Walp. Rep. Bot. Syst. **2**: 417. 1843, as to § *Eucymopterus;* Benth. & Hook. Gen. Pl. **1**: 911. 1867, in part; Port. & Coult. Syn. Fl. Col. 50. 1874, in part;

[80] Mathias, Ann. Mo. Bot. Gard. **15**: 91–108. 1928.

Wats. Bibl. Ind. **1**: 418. 1878, in part; Coult. Man. Bot. Rocky Mt. 118. 1885, in part; Coult. & Rose, Rev. N. Am. Umbell. 21, 76. 1888, in part; Coult. Contr. U. S. Nat. Herb. **2**: 142. 1891 [Bot. West. Texas], in part; Howell, Fl. N. W. Am. **1**: 258. 1898, as to generic description only; Engler & Prantl, Nat. Pflanzenf. 3^8: 221. 1898, in part; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 179. 1900, in part; Small, Fl. S. E. U. S. 874. 1903, and ed. 2. 874. 1913; Rydb. Fl. Col. 257. 1906; Gray, Man. ed. 7. 619. 1908; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 359. 1909, in part; Nels. Spring Fl. Intermt. States, 117. 1912; Britt. & Brown, Ill. Fl. ed. 2. **2**: 644. 1913; Clem. & Clem. Rocky Mt. Fl. 228. 1914, in part; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 482. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 621. 1917, and ed. 2. 621. 1922; Jeps. Man. Fl. Pl. Calif. 729. 1925, in part; Tidestrom, Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.], in part.

Aciphylla Forst. acc. to Baill. Hist. Pl. **7**: 209. 1880, in part.

Coloptera Coult. & Rose, Rev. N. Am. Umbell. 20, 49. 1888; Howell, Fl. N. W. Am. **1**: 250. 1898; Engler & Prantl, Nat. Pflanzenf. 3^8: 222. 1898.

Low, herbaceous, acaulescent or subcaulescent, glabrous or pubescent perennials with long, thickened or fusiform roots. Leaves petiolate, thin to subcoriaceous, bi–quadri-pinnatisect; ultimate leaf divisions 0.5–30 mm. long, 1–10 mm. wide; petioles somewhat sheathing. Inflorescence globose to spreading, peduncles shorter than or exceeding the leaves; involucre absent or present; involucel conspicuous (except in cases of abortion due to the shortening and fusion of the rays forming a disk-like inflorescence), dimidiate, foliaceous, subscarious to subcoriaceous; calyx teeth present or obsolete; flowers white, purple or yellow; stylopodium lacking. Fruit ovate to oblong, flattened dorsally; lateral wings present; dorsal wings present, or absent through abortion; wings more or less thickened, usually constricted near the body of the mericarp; oil tubes small, 1–24 in the intervals, 2–20 on the commissural side, sometimes solitary at the base of the wings in cross-section; strengthening cells at the base of the wing absent or present.

Type species: **Cymopterus acaulis** (Pursh) Raf. Jour. Phys. **89**: 100. 1819.

KEY TO SPECIES

A. Rays of the umbel obsolete, resulting in a discoid inflorescence; involucel bracts scarious and paleaceous.
B. Pseudoscape absent; oil tubes many in the intervals.
D. Foliage pubescent; fruit glabrous.................. *1. C. cinerarius*
DD. Foliage glabrous; fruit pubescent.
G. Fruit 7–10 mm. long, 6–8 mm. broad, commissural surface glabrous to puberulent; flowers white; plants of Arizona deserts.............................. *2. C. megacephalus*
GG. Fruit 5–7 mm. long, 3–6 mm. broad, commissural surface scaly-tomentose; flowers purple; plants of Mojave Desert, California.............................. *3. C. deserticola*
BB. Pseudoscape present; oil tubes mostly solitary in the intervals... *4. C. globosus*
AA. Rays of the umbel present, 0.2–3 cm. long; involucel bracts not paleaceous.
C. Involucel scarious, bracts white or purple; oil tubes solitary in the intervals.
E. Involucel bracts purple; fruit 5–7 mm. long, 3–4 mm. broad, wings of fruit not corrugated...................... *5. C. Coulteri*
EE. Involucel bracts whitish; fruit 3–5 mm. long, 2 mm. broad, wings of fruit corrugated...................... *6. C. corrugatus*
CC. Involucel bracts foliaceous; oil tubes several in the intervals.
F. Pseudoscape present; leaf segments linear or sublinear, usually longer than broad.
H. Peduncles shorter than or equalling the leaves; involucre mostly absent; flowers usually white, central umbellet pedicellate.............................. *7. C. acaulis*
HH. Peduncles longer than the leaves; involucre present; flowers usually yellow, central umbellet sterile and sessile.................................. *8. C. Fendleri*
FF. Pseudoscape absent; leaf segments broad, usually broader than long.................................. *9. C. Newberryi*

1. Cymopterus cinerarius Gray, emend.

Pl. 23, fig. 1; pl. 24, fig. 15; pl. 45.

Cymopterus cinerarius Gray, Proc. Am. Acad. **6**: 535. 1865, in part; Anderson, Cat. Nev. Fl., Rept. Mineral. Nev. **3**: 121. 1871; Brewer & Wats. Bot. Calif. **1**: 267. 1876, in part; Wats. Bibl. Ind. **1**: 418. 1878, in part; Coult. & Rose, Rev. N. Am. Umbell. 80. 1888, in part; Jones, Contr. West. Bot. **12**: 27. 1908; Jeps. Man. Fl. Pl. Calif. 731. 1925.

Aulospermum cinerarium (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 178. 1900, in part; Smiley, Univ. Calif. Publ. Bot. **9**: 282. 1921 [Fl. Sierra Nev. Calif.], in part.

Plants acaulescent, 0.7–0.8 dm. high, pseudoscape never developed; leaves oblong-ovate in general outline, excluding the

petiole, 1.5–2.5 cm. long, 1–2.5 cm. broad, glaucous, hirtellous, tri–quadri-pinnatisect, ultimate segments apiculate, mostly distinct, 1–3 mm. long, about 1 mm. broad, petiole 3–5 cm. long; peduncles exceeding the leaves, umbels compact, discoid due to the abortion of the rays, involucre conspicuous, dimidiate, bracts fused below the middle, frequently tridentate toward the apex, scarious-margined, involucel obscure; fruit narrowly cuneate, about 6 mm. long, 3 mm. broad, lateral wings present, in cross-section barely constricted at the base, subacute at the apex, dorsal wings three, similar to the laterals, oil tubes small, 5–8 in the intervals, 6–10 on the commissure.

Type specimen: *Brewer 1899*, dry hill, Sonora Pass, California, 10,100 feet alt., 1863 (TYPE in the Gray Herbarium of Harvard University; cotype in the Herbarium of the University of California).

Distribution: high mountains of western Nevada and eastern California in the region of Mono Lake.

Specimens examined:

NEVADA: ridge south of Queen Mine on decomposed granites, White Mts., Esmeralda Co., 10,500 ft. alt., 4 Sept. 1926, *Ferris 6735* (D); Mono National Forest, 8000 ft. alt., 19 Aug. 1912, *Holton & Maule* (US 583073).

CALIFORNIA: dry hill, Sonora Pass, 10,100 ft. alt., 1863, *Brewer 1899* (G TYPE, CAL).

Upon a critical examination of the type material of *Cymopterus cinerarius* Gray, it was found to consist of two distinct species. Brewer's collection from Sonora Pass is the first specimen cited by Dr. Gray and corresponds with the specific description and must therefore be taken as the historical type. However, his specimen from above Mono Lake represents the species described by Jones as *Cymopterus aboriginum* var. *oblongus* [= *Aulospermum aboriginum* (Jones) Mathias] and has been found to be identical with Jones' type specimen of that variety. It differs from the plant from Sonora Pass in the development of conspicuous rays. The former specimen, namely, *Brewer no. 1899*, is conspecific with the collections of Ferris from the White Mountains and Holton and Maule from the Mono National Forest. The fruit of *C. cinerarius*, as defined here, differs from that of the Brewer specimen from

"above Mono Lake" in having five to eight oil tubes in the intervals. The conspicuous involucre and cinereous-hirtellous pubescence of the foliage of the Brewer specimen from Sonora Pass positively identify it with the collections of Ferris and Holton and Maule. The pubescence of the Brewer specimen from "above Mono Lake" is quite similar but more pronounced.

2. C. megacephalus Jones, Zoe **2**: 14. 1891; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 182. 1900; Tidestrom, Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.].

Pl. 23, fig. 4; pl. 24, fig. 17; pl. 46, fig. 1.

Plants acaulescent, 1–1.5 dm. high, glabrous (except for pubescence of the fruit), pseudoscape never developed; leaves oblong-ovate in general outline, excluding the petiole, 3–4 cm. long, 1.5–3 cm. broad, coriaceous, tri–quadri-pinnatisect, ultimate segments apiculate, confluent, 0.5–2 mm. long, 0.5–1 mm. broad, petiole 5–7 cm. long; peduncles exceeding the leaves, umbels compact, discoid due to the abortion of the rays, involucre absent, involucel obscure; flowers white; fruit obovate, pubescent with multicellular hairs at the wing tips, 7–10 mm. long, 6–8 mm. broad, lateral wings present, in cross-section somewhat constricted at the base, dorsal wing usually one, similar to the lateral wings, oil tubes 4–7 in the intervals, 8 on the commissure.

Type specimen: *M. E. Jones*, Little Colorado, N. Arizona, 10 June 1890 (TYPE in the United States National Herbarium).

Distribution: known only from the type locality.

Specimens examined:

ARIZONA: Little Colorado, 10 June 1890, *M. E. Jones* (US 47080 TYPE).

3. C. deserticola Brandg. Univ. Calif. Publ. Bot. **6**: 168. 1915; Jeps. Man. Fl. Pl. Calif. 731. 1925.

Pl. 23, fig. 3; pl. 24, fig. 18; pl. 46, fig 2.

Plants acaulescent, about 1.5 dm. high, glabrous (except for pubescence of the fruit), pseudoscape never developed; leaves broadly oblong-ovate in general outline, excluding the petiole, 2–6.5 cm. long, 2–9 cm. broad, tri–quadri-pinnatisect, ultimate segments apiculate, mostly distinct, 1–4 mm. long, about 1 mm.

broad, petiole 4–10 cm. long; peduncles exceeding the leaves, umbels compact, discoid due to the abortion of the rays, involucre absent, involucel bracts paleaceous, mostly aborted; flowers purple; fruit oblong-ovate to cuneate, densely scaly-tomentose on the commissural surface, pubescent with multicellular hairs at the wing tips, 5–7 mm. long, 3–6 mm. broad, lateral wings present, in cross-section barely constricted at the base, dorsal wings absent or much aborted to 3 inconspicuous ridges, oil tubes 3–5 in the intervals, 12–17 on the commissure.

Type specimen: *K. Brandegee*, Kramer, California, May 1913 (TYPE in the Herbarium of the University of California).

Distribution: Mojave Desert, San Bernardino Co., California.

Specimens examined:

CALIFORNIA: Kramer, May 1913, *K. Brandegee* (CAL 173143 TYPE); common in stretch of loose, sandy soil 5 mi. southeast of Victorville, 2950 ft. alt., 17 May 1920, *I. M. Johnston 2304* (D, R, US); sandy plains between Victorville and Rabbit Springs, San Bernardino Co., 24 April 1915, *Parish 9742* (CAL); between Victorville and Deadman's Point, San Bernardino Co., 25 April 1915, *Parish 9742* (D).

4. **C. globosus** Wats. Proc. Am. Acad. **11:** 141. 1876; Bibl. Ind. **1:** 418. 1878; Coult. & Rose, Rev. N. Am. Umbell. 77. 1888; Hillman, Nev. Agr. Exp. Sta. Bull. 24: 46. 1894 [Fl. Truckee Valley]; Coult. & Rose, Contr. U. S. Nat. Herb. 7: 183. 1900; Jones, Contr. West. Bot. 12: 18. 1908; Tidestrom, Contr. U. S. Nat. Herb. **25:** 298. 1925 [Fl. Utah & Nev.].

Pl. 23, fig. 2; pl. 24, fig. 16; pl. 47, fig. 1.

"*C. montanus* Nutt." acc. to Wats. Bot. King's Exp. 123. 1871, as to Beckwith collections; acc. to Torr. & Gray, Pacif. R. R. Rept. **2:** 121. 1885, as to specimen cited.

C. montanus var. *globosus* Wats. Bot. King's Exp. 124. 1871, excl. fruit.

Plants subcaulescent with the development of a pseudoscape, 0.3–2 dm. high, glabrous; leaves oblong-ovate in general outline, excluding the petiole, 1–7 cm. long, 0.5–6 cm. broad, subglaucous, bi-tri-pinnatisect, ultimate segments minutely apiculate, confluent, 0.5–6 mm. long, 0.5–4 mm. broad, petiole 1–10 cm. long;

peduncles equalling or exceeding the leaves, umbels compact, discoid due to the abortion of the rays, involucre absent, involucel bracts scarious, linear, paleaceous, entire, shorter than the white or sometimes purple flowers; fruit narrowly cuneate or abruptly constricted below the middle, 6–11 mm. long, 3–7 mm. broad, lateral wings present, in cross-section occasionally somewhat constricted at the base, usually acute at the apex, dorsal wings usually 3, similar to the lateral wings, oil tubes large, mostly solitary in the intervals, 2–4 on the commissure, sometimes solitary in each wing, strengthening cells mostly absent.

Type specimen: *Watson 449*, Carson City, N. Nevada, 5000 ft. alt., April 1868. (TYPE in the Gray Herbarium of Harvard University; cotypes in the United States National Herbarium as *no. 449a* and the New York Botanical Garden Herbarium).

Distribution: western Utah, Nevada, and California.

Specimens examined:

UTAH: Willow Springs Pass, 5 June 1891, *M. E. Jones* (P 82073); Deep Creek, 4 May 1904, *M. E. Jones* (P 82207).

NEVADA: Goshoot Mts., 14 May 1854, *Beckwith* (G, NY); Franktown Creek, Washoe Co., 18 May 1907, *C. L. Brown* (NEV 9630); Reno, 12 May 1896, *Hillman* (P 82070); 1882, *M. E. Jones* (US 44317); Empire City, May 1882, *M. E. Jones* (CAL 373248); Empire City, 20 May 1882, *M. E. Jones 3885* (CAS, D, F, NY, P, PA, R, US); Carson City, 5000 ft. alt., 29 May 1897, *M. E. Jones* (D 148931, M, P 82074, US 359180); Reno, 4500 ft. alt., 27 May 1903, *M. E. Jones* (CAS 153900, D 148932, M, NY, P 82210, US 855681, 855682, 856506); Currie's, 6000 ft. alt., 22 May 1906, *M. E. Jones* (D 148933, P 82208); Cobre [Currie's ?], 6000 ft. alt., 22 May 1906, *M. E. Jones* (D 148934, P 82209); Goldfield, 6500 ft. alt., 24 April 1907, *M. E. Jones* (P 82071); Cobre, 6000 ft. alt., 22 May 1910, *M. E. Jones* (P 82209); Wadsworth, 5 May 1904, *Kennedy 872* (NEV in part); near Pyramid Lake, May 1879, *J. G. Lemmon* (G); April 1886, *Shockley* (US 44315); among basalt, Candelaria, Esmeralda Co., March 1888, *Shockley* (N in part); Candelaria, April 1888, *Shockley* (CH 374254 in part); in basaltic rocks and nowhere else, Esmeralda Co., 6000–7000 ft. alt., May 1883, *Shockley 208* (D); Reno, Washoe Co., May 1890, *Sonne* (CAL 193744); Carson, April 1865, *Stretch* (NY);

Carson City, April 1865, *Stretch 162* (G); Carson City, 5000 ft. alt., April 1868, *Watson 449* (G TYPE, NY); Carson City, 5000 ft. alt., April 1868, *Watson 449a* (US).

CALIFORNIA: Benton, 4000 ft. alt., 26 April 1897, *M. E. Jones* (P 82072).

5. C. Coulteri (Jones) Mathias, new comb.

Pl. 23, fig. 6; pl. 24, fig. 19; pl. 48.

Rhysopterus Jonesii Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 186. 1900; Tidestrom, Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.].

Cymopterus corrugatus var. *Coulteri* Jones, Contr. West. Bot. 12: 19. 1908.

C. corrugatus var. *scopulicola* Jones, Contr. West. Bot. 14: 39. 1912.

Phellopterus Jonesii (Coult. & Rose) Rydb. Fl. Rocky Mts. 619. 1064. 1917, and ed. 2. 619, 1064. 1922.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.4–1 dm. high, glabrous; leaves ovate in general outline, excluding the petiole, 1.5–4 cm. long, about as broad, bipinnatisect, ultimate segments obtuse, confluent, 0.2–1 cm. long, 0.5–3 mm. broad, petiole 0.5–4 cm. long; peduncles usually slightly exceeding the leaves, umbels of several unequal rays, rays 0.2–1 cm. long, involucre absent, involucel bracts usually exceeding the white flowers, subscarious, purple, linear, entire, acute at the apex; fruit ovate-oblong, 5–7 mm. long, 3–4 mm. broad, lateral wings present, in cross-section not constricted at the base, tapering gradually toward the apex, dorsal wings three, similar to the lateral wings, oil tubes solitary in the intervals, 2 on the commissure.

Type specimen: *M. E. Jones 1691*, Juab, Utah, 4000 ft. alt., 30 April 1880 (TYPE in the United States National Herbarium, 227174; cotypes in the United States National Herbarium, 258913, Missouri Botanical Garden Herbarium, the Gray Herbarium of Harvard University, Parry Herbarium, and Pomona College Herbarium).

Distribution: western Utah.

Specimens examined:

UTAH: Rush Valley [Long. 112°, Lat. 40°], 2 May 1859, *H.*

Engelmann (M); lower temperate life zone, Sevier Bridge, 5500 ft. alt., 26 April 1910, *M. E. Jones* (D 148929, 149808, P 82077); Gunnison, 18 April 1911, *M. E. Jones* (P 82254); Juab, 4000 ft. alt., 30 April 1880, *M. E. Jones 1691* (US 227174) TYPE, 258913, G, M, P, PAR).

The specific name *Coulteri* is here adopted in preference to the older name *Jonesii* which has been variously used in this group of closely related genera. Because of the possibilities of confusion by its continued use and since the name has been previously applied to a species described under *Cymopterus*,[31] it is felt inadvisable to retain the name *Jonesii* for this species.

6. **C. corrugatus** Jones, Am. Nat. **17**: 973. 1883; Coult. & Rose, Rev. N. Am. Umbell. 77. 1888, excl. *M. E. Jones no. 1691;* Jones, Contr. West. Bot. 12: 18. 1908.

Pl. 23, fig. 5; pl. 24, fig. 20; pl. 49.

Rhysopterus corrugatus (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 187. 1900; Tidestrom, Contr. U. S. Nat. Herb. **25**: 399. 1925 [Fl. Utah & Nev.].

Plants acaulescent or subcaulescent with the development of a pseudoscape, glabrous, 3–10.5 cm. high; leaves oblong-ovate in general outline, excluding the petiole, 0.5–4 cm. long, about as broad, bipinnatisect, ultimate segments minutely apiculate, confluent, 1–5 mm. long, 0.5–2 mm. broad, petiole 1–4 cm. long; peduncles shorter than or equalling the leaves, umbels several-rayed, rays 0.2–1 cm. long, involucre absent, involucel bracts shorter than the white flowers, scarious to submembranous, entire, acute at the apex; fruit ovate-oblong, 3–5 mm. long, about 2 mm. broad, lateral wings present, thin and corrugated, in cross-section constricted at the base, dorsal wings 3, similar to the lateral wings, oil tubes solitary in the intervals, 2–4 on the commissure.

Type specimen: *M. E. Jones 3886*, Humboldt Lake (near Rose Creek), Nevada, 17 June 1882 (TYPE in the United States National Herbarium, 42473; cotypes in the United States National Herbarium, 42474, 1100260, and the herbaria of the Academy of Natural Sciences, Philadelphia, the California Academy of Sciences, and Pomona College).

[31] *Cymopterus Jonesii* Coult. & Rose, Rev. N. Am. Umbell. 80. 1888.

Distribution: western Nevada.

Specimens examined:

NEVADA: deserts east of Carson Lake, 4 June 1859, *H. Engelmann* (M); Rose Creek, 25 May 1882, *M. E. Jones* (P 82079); Mill City, 28 May 1903, *M. E. Jones* (P 82080); Copperfield near Hawthorne, 22 April 1907, *M. E. Jones* (P 82081); Rose Creek, 15 May 1882, *M. E. Jones 37* (C); Humboldt Lake, 17 June 1882, *M. E. Jones 3886* (US 42473 TYPE, 42474, 1100260, CAS, PA, P); between Wadsworth and Mud Lake, 5 May 1902, *Kennedy* (US 413906); Wadsworth, 5 May 1904, *Kennedy 872* (NEV 3789 in part, R).

7. C. acaulis (Pursh) Raf. Jour. Phys. **89**: 100. 1819; in Seringe, Bull. Bot. **1**: 216. 1830; Good Book **1**: 56. 1840.

Pl. 24, fig. 21; pl. 50; pl. 51, fig. 1,

Selinum acaule Pursh, Fl. Am. Sept. **2**: 732. 1814, and ed. 2. **2**: 732. 1816, *non* Cav. Icon. et Descr. **5**: 59, *t. 487, fig. 2.* 1799, *nec* Turcz. ex Bess. in Flora **17**[1]: Beibl. 13. 1834.

Thapsia glomerata Nutt. Gen. **1**: 184. 1818.

Cymopterus glomeratus (Nutt.) Raf. Jour. Phys. **89**: 100. 1819; in Seringe, Bull. Bot. **1**: 216. 1830; Good Book **1**: 56. 1840; Steud. Nom. Bot. ed. 2, **1**: 461. 1840; Wats. Bibl. Ind. **1**: 418. 1878; Upham, Minn. Geol. & Nat. Hist. Surv. Ann. Rept. **1883**[6]: 61. 1884 [Cat. Fl. Minn.]; Coult. Man. Bot. Rocky Mt. 119. 1885; Coult. & Rose, Rev. N. Am. Umbell. 76. 1888.

C. glomeratus (Nutt.) DC. Prodr. **4**: 204. 1830; Torr. & Gray, Fl. N. Am. **1**: 623. 1840; Walp. Rep. Bot. Syst. **2**: 417. 1843; Port. & Coult. Syn. Fl. Col. 50. 1874.

Ferula ? Palmella Hook. Fl. Bor.-Am. **1**: 268. 1834.

Coloptera Parryi Coult. & Rose, Rev. N. Am. Umbell. 50. 1888; Howell, Fl. N. W. Am. **1**: 250. 1898.

Cymopterus Parryi (Coult. & Rose) Jones, Zoe **4**: 48. 1893; Contr. West. Bot. 4: 48. 1893; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 182. 1900; Rydb. Fl. Col. 251. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 359. 1909; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922.

Cymopterus acaulis (Pursh) Rydb. Bot. Surv. Nebr. 3: 38. 1894; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 181. 1900; Small, Fl.

S. E. U. S. 874. 1903, and ed. 2. 874. 1913; Rydb. Fl. Col. 257. 1906; Gray, Man. ed. 7. 619. 1908; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 359. 1909; Nels. Spring Fl. Intermt. States, 118. 1912; Britt. & Brown, Ill. Fl. ed. 2. **2**: 644. 1913; Clem. & Clem. Rocky Mt. Fl. 228. 1914; Lunell, Am. Midl. Nat. **4**: 485. 1916 [Enum. Pl. Dak. **8**: 117]; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922.

C. glomeratus var. *Parryi* (Coult. & Rose) Jones, Proc. Calif. Acad. Sci. II, **5**: 688. 1895; Contr. West. Bot. 7: 688. 1895; *ibid.* 12: 25. 1908.

C. Leibergii Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 182. 1900; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922.

C. glomeratus var. *Leibergii* (Coult. & Rose) Jones, Contr. West. Bot. 12: 25. 1908.

C. lucidus Osterh. Muhlenbergia **6**: 59. 1910; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.3–3 dm. high, glabrous; leaves ovate to oblong-obovate in general outline, excluding the petiole, 1–9 cm. long, 0.5–7 cm. broad, bi–tri-pinnatisect, ultimate segments acute or somewhat obtuse, sometimes more or less confluent, 0.5–30 mm. long, 0.5–5 mm. broad, petiole 1–14 cm. long; peduncles usually shorter than or equalling the leaves, umbels several-rayed, rays 0.2–1 cm. long, involucre absent or rarely present in vestigial form, involucel bracts equalling or exceeding the white flowers, sometimes more or less membranous, occasionally scarious-margined, usually linear, unlobed and obtuse at the apex; fruit ovate to ovate-oblong, 5–10 mm. long, 3–8 mm. broad, lateral wings present, in cross-section constricted at the base and sometimes acuminate at the apex, dorsal wings 1–3, similar to the lateral wings, oil tubes 3–17 in the intervals, 5–13 on the commissure, sometimes one at the base of each wing, strengthening cells absent or present.

Type specimen: *Bradbury*, "on the alluvion of the Missouri, from the river Naduet to the Mahas" in "upper Louisiana," 1811 (TYPE in the Kew Herbarium; probable cotype in the New York Botanical Garden Herbarium; photograph of the type in the Missouri Botanical Garden Herbarium).

Distribution: central Saskatchewan to southern Colorado, western Minnesota to eastern Oregon.

Specimens examined:

Minnesota: south bend of the Red River of Minnesota [Long. 96°, Lat. 46°], 18 May 1857, *Lapham* (PA).

North Dakota: in stony loam on hillside, Washburn, 31 May 1912, *Bergman 1589* (M, MU, NY); western Dakota, *Cod 514* (MU); prairie, Bismarck, May 1891, *Lanterman* (A, F, IAC, MU, NY); in gravel, Pleasant Lake, Benson Co., 26 May–11 June 1912, *Lunell* (US 889867); in deep gravel on rolling prairie, Pleasant Lake, Benson Co., 21 May–11 June 1912, *Lunell 264* (MU 260124); in dry soil, Williston, 2 May 1906, *Lunell 778* (MU 260203); gravelly rolling prairie, Pleasant Lake, Benson Co., 21 May 1912, *Lunell 778* (MU 260212); in deep gravel on rolling prairie, Pleasant Lake, Benson Co., 1600 ft. alt., 11 June 1912, *Lunell 778* (MU 260213); "alkelin" flat, bed of creek, Marmarth, 7 June 1914, *Moyer 467* (MU); upp. Missouri, Stevens Exp., 1853, *Suckley* (G).

South Dakota: Smithville, 1 June 1894, *Bailey 12* (US); prairie, Newell, 1 May 1913, *Carr 6* (F, G, M, MU, NY, R, US); bluffs of upper Missouri, May 1879, *Havard* (US 140663); Running Water, April 1853, *Hayden* (M); cretaceous rocks near mouth of White River, 16 June 1853, *Hayden* (M); [Black Hills region], 1875, *Jenney Exp.* (G); clay soil, Chamberlain, Brule Co., 6 May 1914, *Over 2832* (US); Edgemont, 3500 ft. alt., 27 May 1892, *Rydberg 727* (US).

Nebraska: Valentine, 30 May 1891, *Bates* (G); Long Pine, 10 April 1895, *Bates* (B); Long Pine, May 1898, *Bates* (B); Long Pine, 1 June 1899, *Bates* (B, R 18269); Chadron, 17 May 1914, *Bates* (MU 163440); Valentine, 20 May 1914, *Bates 5915* (MU); *Bradbury* (NY); up the Missouri, *Bradbury 100* (K type, M photograph); "Puncah" [Ponca ?] Village, 16 June 1853, *Hayden* (M in part); *Le Roy* (NY); Ft. Niobrara, May 1888, *Wilcox* (NY).

Kansas: stony hills, Logan Co., 9 May 1895, *A. S. Hitchcock 191* (G in part, M, NY, US).

Oklahoma: hillside, near Freedom, Woods Co., 29 April 1913, *Stevens 232* (D, G, M, MU, US); on sandy prairie, near Camp, Texas Co., 12 May 1913, *Stevens 413* (D, G, MU); hillside, near

Shattuck, Ellis Co., 10 May 1914, *Stevens 3032* [Coll. *R. L. Clifton*] (G); on prairie hillside near Alva, Woods Co., 10 May 1914, *Stevens 3052* (D, G, M, MU, NY, US); on "gypy" hill-top, near Shattuck, Ellis Co., 7 June 1914, *Stevens 3184* [Coll. *R. L. Clifton*] (G).

SASKATCHEWAN: Regina, 1884, *Cowdry* [*101224*] (CAN); about Carlton House, on the Saskatchewan, *Drummond* (CAN, PA); *Taylor 22* (K, M photograph); gravelly slopes, Moose Mountain Creek, 6 June 1883, *Macoun 875, 2167, 9281* (CAN); clay bank, Old Wives Creek, 27 May 1895, *Macoun 10675* (CAN, N).

ALBERTA: clay cliffs, Lethbridge, 5 June 1894, *Macoun 4965* (CAN, G); Medicine Hat, 31 May 1894, *Macoun 4966* (G); Medicine Hat, 22 April, 31 May 1894, *Macoun 4966, 4967* (M, MU, NY, US); dry clay soil, Rosedale camp, near Rosedale, 2200–2500 ft. alt., 30 April 1915, *Moodie 819* (D, F, G, NY, US); clay banks, Medicine Hat, 22 April, 13 May, 31 May 1894, *Spreadborough* [*4966, 4967, 85015*] (CAN).

MONTANA: Custer Station, 24 April 1890, *Blankinship* (US 856412); Custer, 4 May 1890, *Blankinship* (IAC 35005); dry uplands, Lombard, 1 June 1901, *Blankinship* (G, NY); Miles City, 26 May 1902, *Blankinship* (G); 3 May 1890, *Blankinship 16* (US); Custer, 4 May 1890, *Blankinship 16* (CAS, M); Billings, April 1887, *Kelsey* (US); Gallatin Co., 5000 ft. alt., May 1888, *Tweedy* (US); dry benches, Gallatin Co., 5000 ft. alt., May 1888, *Tweedy 2* (CAL, CH, NY); Big Muddy River from Great Falls to 30 miles north, 15 May 1900, *E. V. Wilcox 18* (US); Billings, *E. V. Wilcox 134* (US); Great Falls, 12 June 1887, *R. S. Williams* (CH 402336, US 44318); Great Falls, 26 April–24 June 1891, *R. S. Williams 13* (MU, US).

WYOMING: Cheyenne, June 1897, *Clement 521* (R); Cheyenne, 1893, *Havard* (US); Sheep Creek, 10 May 1900, *Hatcher* (C 1608); Granger, 24 June 1896, *M. E. Jones* (US 279309); 22 miles s. w. of Edgemont [S. Dak.], 25 May 1919, *Miller* (CAS 42270); Ft. Bridger, 9 June 1898, *A. Nelson 4604* (R); Granger, 10 June 1898, *A. Nelson 4623* (C, G, M, NY, R, US); sandy-clay hillsides, Sand Creek, Albany Co., 31 May 1900, *A. Nelson 6978* (C, G, M, MU, NY, P, R, US); dry, sandy bottoms, Wendover, Laramie Co., April 1902, *A. Nelson 8845* (G, M, US); dry plains, Cheyenne,

May 1902, *A. Nelson 8846* (R); on the red hills north of the city, Laramie, Albany Co., 31 May 1899, *Nelson & Nelson 6829* (M, NY, R, US); Laramie, 31 May 1900, *E. Nelson 202* (NY); Little Sandy, 1873, *Parry* (G); north-western Wyoming Expedition, 1873, *Parry 123* (M, PAR); dry flats, 21 miles west of Green River, 19 June 1923, *Payson & Armstrong 3207* (IAC, G, M, R); dry sandy plains and rocky hills, Fort Steele, Carbon Co., 6500 ft. alt., 25 May–10 June 1901, *Tweedy 4505* (NY, US).

Colorado: plains, Larimer Co., 5000 ft. alt., 30 March, 18 May 1895, *C. F. Baker* [*Patterson 3934*] (CAL, F, M, N, NY, OAC, P, R); plains, Larimer Co., 5000 ft. alt., 1 May 1895, *C. F. Baker* [*Patterson 3934*] (G, M, R, US); Denver, May 1894, *Bethel* (F 98835); plains, Denver, 5000 ft. alt., May 1895, *Bethel 36-1* (US); Cañon City, 1871, *T. S. Brandegee* (M in part); Cañon City, 1872, *T. S. Brandegee* (CAL 174281 in part, PA); gravel, "Cemetery" Prairie, Colorado Springs, 14 June 1912, *Churchill* (M 782191); dry soil, Denver, 5300 ft. alt., 15 May 1918, *Clokey 3041* (CAS, G, M, NY, R, US); Clear Creek, 21 May 1873, *Coulter* (PA); bank of Poudre, 29 April 1891, *Cowen* (IAC 17519); bank of Cache La Poudre, 23 May 1891, *Cowen* (US 216532); bank of Poudre, 10 April 1892, *Cowen* (NY); river bank, Fort Collins, 5000 ft. alt., 29 April 1891, *Cowen 184* (US); Fort Collins, 5000 ft. alt., 9 May 1894, *Crandall* (NY); Fort Collins, 5000 ft. alt., 24 May 1894, 27 April 1897, *Crandall* (M); Ft. Collins-East, 3 May 1896, *Crandall* (NY); dry plains, Fort Collins, 5000 ft. alt., 3 May 1896, *Crandall* (R 16962, WSC 8400); Fort Collins, 5000 ft. alt., 3–24 May 1896, *Crandall* (CAL 140621); dry plains, 5000 ft. alt., 28 April, 24 May 1894, *Crandall 9* (US); dry ground, Fort Collins, 5000 ft. alt., 28 April, 24 May 1894, *Crandall 258* (G); Fort Collins East, 3 May 1896, *Crandall 1366* (NY, R); river bank, 27 April 1897, *Crandall 1369* (US, WSC); sandy soil, Denver, 15 May 1901, *Dwight 1* (UC); Denver, 1891, *Eastwood* (US); (Golden City, etc.), 1870, *Greene* (G); near Greeley, May 1872, *Greene* (N); plains near Greeley, 7 May 1872, *Greene 16* (G); plains, common, American Plains Flora, Lat. 40°, 1862, *E. Hall* (B 10478, F, PA); American Plains Flora, Lat. 41°, 1862, *Hall & Harbour 210* (B, CAS, F, G, M, PAR, US); Rocky Mt. Flora, Lat. 39°–41°, 1862, *Hall & Harbour 210* (PA); American

Plains Flora, Lat. 41°, 1862, *Hall & Harbour 211* (US); Denver, 5000 ft. alt., April 1886, *Harper* (M 965042); Pueblo, June 1890, *G. H. Hicks 157* (G in part); Pueblo, June 1890, *Hicks & Hicks 157* (US); near Denver, 5000 ft. alt., 25 May–10 June 1896, *Holzinger 6, 7, 8, 11* (US); Grasshopper hill, Denver, May 1891, *Hughes 27* (G); wet draws west of town, Trinidad, 14 June 1917, *E. L. Johnston 544* (G); hills west of town, Trinidad, 14 June 1917, *E. L. Johnston 546* (G); Trinidad, road to Walsenburg, 20 June 1917, *E. L. Johnston 1004* (G); plains, Colorado Springs, 3 May 1878, *M. E. Jones 16* (D, F, M, NY); Arkansas, *Nuttall* (G, NY); "R. Mts.", *Nuttall* (G, NY, PA); plains, New Windsor, May 1894, *Osterhout* (MU 163434); New Windsor, May 1895, *Osterhout* (MU, PA, US 223477); Windsor, Weld Co., May 1895, *Osterhout* (P 82880); New Windsor, 20 May 1897, *Osterhout* (MU 163433); McCoys, Eagle Co., 14 June 1903, *Osterhout 2753* (NY, P, R); Las Animas, Bent Co., 16 June 1909, 16 April 1910, *Osterhout 3905* (NY); New Windsor, Weld Co., 4 June 1909, *Osterhout 4139* (MU); Fort Lyon on the Arkansas, 9 April 1863, *E. Palmer* (NY, US 44319); upper Platte east of "Middle Park," May 1861, *Parry 160* (PAR); near Boulder, about 1700 m. alt., 7 May 1905, *Ramaley 1001* (R); mesas near Pueblo, 1500–1600 m. alt., 12 May 1900, *Rydberg & Vreeland 5816* (US); Butte, 5 miles southwest of La Veta, 2200–2400 m. alt., 22 May 1900, *Rydberg & Vreeland 5817* (NY, US); Cuchara Valley, near La Veta, 2100 m. alt., 17 May 1900, *Rydberg & Vreeland 5818* (NY); mesas near Pueblo, 1500–1600 m. alt., 12 May 1900, *Rydberg & Vreeland 5819* (NY, US); plains near Denver, 1500 m. alt., 8 May 1900, *Rydberg & Vreeland 5820* (NY, R, US); Walsenburg, 1800 m. alt., 5 June 1900, *Rydberg & Vreeland 5821* (NY); transition zone, near Leadville, *Schedin & Schedin 292* (R 97268); short grass, exposed hill top, Evans Hill, Denver, 22 May 1922, *Schmoll 470* (UC); exposed hill top, Evans Hill, Denver, 15 May 1922, *Schmoll 473a* (UC); Denver, April 1881, *B. H. Smith* (PA); Denver, May 1891, *E. C. Smith* (M, WSC 16961); dry roadsides, Colorado Springs, El Paso Co., 14 May 1903, *Sturgis* (G); plains east of Denver, Arapahoe Co., 11 May 1912, *Vestal 353* (D); Denver, *C. S. Williamson* (PA); Denver, June 1873, *Wolf 711* (F, US); Denver, 1873, *Wolf & Rothrock 711* (PA).

Idaho: *Canby* (US); dry flat, Challis, Custer Co., 5400 ft. alt., *Macbride & Payson 3210* (G); Blue Lakes, Snake Plains, 3 June 1893, *E. Palmer 67* (US).

Oregon: white, adobe, gravelly hilltops, near Rockville, Malheur Co., 24 May 1927, *Henderson 9251* [*7251 ?*] (CAS); white, chalky soil, hillsides, near Harper, Malheur Co., 28 March 1927, *Henderson 9252* [*7252 ?*] (CAS); loose yellowish-white soil, on hills near Rockville, Malheur Co., 25 April 1927, *Henderson 9278* [*7278 ?*] (CAS); loose ground, on hill, Owyhee River, near Symes' Ranch, op. Watson, Malheur Co., 27 April 1927, *Henderson 9290* [*7290 ?*] (CAS); Malheur Valley near Harper Ranch, 900 m. alt., 12 June 1896, *Leiberg 2253* (O, US).

8. C. Fendleri Gray, Mem. Am. Acad. N. S. **4**: 56. 1849 [Pl. Fendl.]; Walp. Ann. Bot. Syst. **2**: 715. 1851–52; Wats. Bibl. Ind. **1**: 418. 1878; Coult. & Rose, Rev. N. Am. Umbell. 79. 1888; Coult. Contr. U. S. Nat. Herb. **2**: 142. 1891 [Bot. West. Texas]; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 183. 1900; Rydb. Fl. Col. 257. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 360. 1909; Nels. Spring Fl. Intermt. States, 118. 1912; Clem. & Clem. Rocky Mt. Fl. 228. 1914; Wooton & Standl. Contr. U. S. Nat. Herb. **19**: 482. 1915 [Fl. New Mex.]; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.].

Pl. 23, fig. 7; pl. 24, figs. 1–14; pl. 51.

C. decipiens Jones, Zoe **2**: 246. 1891.

Plants acaulescent or subcaulescent with the development of a pseudoscape, 0.4–3 dm. high, glabrous; leaves ovate to oblong-obovate in general outline, excluding the petiole, 1–7.5 cm. long, 0.5–6 cm. broad, bi–quadri-pinnatisect, ultimate segments mostly obtuse, sometimes acute, frequently confluent, 0.5–5 mm. long, 0.5–4 mm. broad, petiole 1.2–12 cm. long; peduncles usually equalling or exceeding the leaves, umbels several-rayed, rays 0.2–2.5 cm. long, central umbellet sessile and sterile, involucre usually present in the form of a low sheath, sometimes with 1–3 linear bracts, involucel bracts equalling or exceeding the yellow flowers, subscarious to foliaceous, linear to ovate-oblong, frequently 3-toothed, usually acute at the apex; fruit ovate to ovate-oblong,

0.5–1.3 cm. long, 0.4–1 cm. broad, lateral wings present, in cross-section narrowed at the base and sometimes acuminate at the apex, dorsal wings 1–3, similar to the lateral wings, oil tubes 3–16 in the intervals, 6–12 on the commissure, sometimes one at the base of the wing, strengthening cells absent or present.

Type specimen: *Fendler 274*, "Gravelly hills, Santa Fe," New Mexico, April–May 1847 (TYPE in the Gray Herbarium of Harvard University; cotypes in the herbaria of the Missouri Botanical Garden, United States National Museum, New York Botanical Garden, and the Academy of Natural Sciences, Philadelphia).

Distribution: northern Utah to northern Chihuahua, central New Mexico to Central Arizona.

Specimens examined:

COLORADO: dry creek crossing, Paldos Road, Montrose Road, *Brewster* (UC); dry mesa, Grand Junction, 4500 ft. alt., 28 May 1894, *Crandall 13* (US); adobe soil, Mancos, 15 June 1890, *Eastwood* (US 44320); Mancos, May–June 1891, *Eastwood* (CH 364674, US 44322); Grand Junction, May 1912, *Eastwood* (CAS 42275); Grand Junction, Gunnison Mesa, 15 May 1916, *Eastwood 5116* (CAS); Grand Junction, 17 May 1906, *Ferril* (UC); American Plains Flora, Lat. 40°, 1862, *E. Hall* (PA); 50 miles s. of Ferry, 12 June 1890, *M. E. Jones* (P 82243); Grand Junction, 16 April 1891, *M. E. Jones* (P 82244); Grand Junction, 4400 ft. alt., 22 May 1895, *M. E. Jones* (P 82042, 82247, US 238314); low plains, Mesa Co., May–July 1893, *Long* (G); De Beque, Mesa Co., 19 May 1911, *Osterhout 4487* (NY, P); dry hills, Naturita, 5400 ft. alt., 6 May 1914, *E. Payson 274* (C, F, G, M, R); dry slopes, Naturita, western Montrose Co., 5800 ft. alt., 20 June 1924, *Payson & Payson 3867* (R); "an den abhängen der Bluffs am Gunnison Riv. Mesa gr.," Delta Co., 5000–6000 ft. alt., May 1892, *Purpus 835* (CH); occasional on mesa, west of Delta, 1500 m. alt., 6 June 1909, *Tidestrom 2190* (US); near Bareta, 4 June 1900, *T. A. Williams* (CAS 42271).

UTAH: McElmo Creek, June 1892, *Eastwood* (P 82241); Westwater, May 1890, *M. E. Jones* (G, US 44321); Cisco, 2 May 1890, *M. E. Jones* (B, CAL 106594, CAS 139226, D 148925, G, M, NY, P 82242, US 44323); Green River, 7 May 1891, *M. E. Jones* (P 82245, R 26721); Westwater, 7 May 1891, *M. E. Jones* (P 82246);

Green River, 4400 ft. alt., 22 May 1895, *M. E. Jones* (D 148928, M, P 82041, US 238312); Westwater, 20 May 1901, *M. E. Jones* (D 148923); San Rafael Swell, 8 May 1914, *M. E. Jones* (P 83098); San Rafael Swell, 12 May 1914, *M. E. Jones* (NY); San Rafael Swell, 18 May 1914, *M. E. Jones* (CAS 139138); San Rafael Swell, 19 May 1914, *M. E. Jones* (P 83099); Green River, 19 May 1914, *M. E. Jones* (CAS 139137, D 148721); Green River, 23 May 1914, *M. E. Jones* (CAL 303390, P 83096); San Rafael Swell, 28 May 1914, *M. E. Jones* (P 83100).

New Mexico: Santa Fe, 1891, *Alcott* (M 890643); La Bajada, 15 May 1926, *Benedict 2402* (US); near Las Vegas, *Mrs. T. D. A. Cockerell* (CAS 41394); Sandia Mountains near Madera, 1 July, *Ellis 263* (US); [Gravelly hills, Santa Fe], April–May 1847, *Fendler 274* (G type, M, NY, PA, US); Albuquerque, May 1900, *Harward* (M, US 338051); hills at Santa Fe, Santa Fe County, 7300 ft. alt., 15 May 1897, *Heller & Heller 3539* (B, D, G, M, MU, N, NY, P, US); on the mesa about two miles east of Albuquerque, 5000 ft. alt., 1915, *Kammerer 47* (M, NY, US); dry rocky ground, Sandia Mountains, near Albuquerque, Bernalillo Co., 21 June 1926, *E. J. Palmer 31160* (M, PA); near the Mimbres, May 1851, *Thurber* (G); River Mimbres, May 1851, *Thurber* (G); Mexican Boundary Survey, May 1851, *Thurber* (F 306405); Bloomfield, San Juan Co., 1892, *Waring 18* (PA); Mexican Boundary Survey, *Wright* (NY).

Arizona: Holbrook, 19 May 1901, *M. Z. Hough* (F 452604); Holbrook, 5200 ft. alt., 1901, *W. Hough 60* (US); X Ranch, 18 miles north of Holbrook, May 1901, *W. Hough 104* (US); [Pottery Hill, Blue Peaks, Moqui Country], 8 May 1858, *Newberry* (G, US 41977); Ash Fork, May 1883, *Rusby 635½* (G, US); Holbrook, May 1883, *Rusby 635½* (NY); *Voth 85* (F 118848 in part); twelve miles northwest of Winslow, 10 May 1901, *Ward* (US 410082); Grand Falls, Cascade of the Little Colorado (above the Falls), 13 May 1901, *Ward* (US 410080); Holbrook, 18 June 1901, *Ward* (US 410081); Holbrook, 6 May 1899, *Zuck* (US 664240).

Chihuahua: Xanos [Janos], March 1852, *Parry* (PAR).

9. C. Newberryi (Wats.) Jones, Zoe **4**: 47. 1893; Contr. West. Bot. 4: 47. 1893; Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 184.

1900; Rydb. Fl. Col. 257. 1906; Coult. & Nels. Man. Bot. Cent. Rocky Mts. 360. 1909; Clem. & Clem. Rocky Mt. Fl. 228. 1914; Rydb. Fl. Rocky Mts. 622. 1917, and ed. 2. 622. 1922; Tidestrom, Contr. U. S. Nat. Herb. **25**: 398. 1925 [Fl. Utah & Nev.].

Pl. 23, fig. 8; pl. 24, figs. 22–23; pl. 25, figs. 2–3; pl. 47, fig. 2.

Peucedanum Newberryi Wats. Am. Nat. **7**: 301. 1873.

Ferula Newberryi Wats. Proc. Am. Acad. **11**: 145. 1876; Bibl. Ind. **1**: 423. 1878.

Coloptera Newberryi (Wats.) Coult. & Rose, Rev. N. Am. Umbell. 49. 1888.

C. Jonesii Coult. & Rose, Rev. N. Am. Umbell. 50. 1888.

Cymopterus Newberryi var. *alatus* Jones, Zoe **4**: 47. 1893; Contr. West. Bot. 4: 47. 1893.

C. Newberryi var. *Jonesii* (Coult. & Rose) Jones, Proc. Calif. Acad. Sci. II. **5**: 684. 1895; Contr. West. Bot. 7: 684. 1895.

C. Fendleri var. *Newberryi* (Wats.) Jones, Contr. West Bot. 12: 19. 1908.

Plants acaulescent or subcaulescent, 0.4–2 dm. high, glabrous, pseudoscape never developed; leaves ovate to oblong-obovate in general outline, excluding the petiole, 1–4 cm. long, 1.5–4 cm. broad, bi–tri-pinnatisect, ultimate segments obtuse, confluent, about 1 mm. long, 1–5 mm. broad, petiole 8–10 cm. long; peduncles usually exceeding the leaves, umbels several-rayed, rays 0.5–3 cm. long, central umbellet frequently sessile and sterile, involucre usually present in the form of a low sheath, sometimes with 1–3 linear bracts, involucel bracts equalling or exceeding the yellow flowers, usually foliaceous, linear, acute at the apex; fruit ovate-oblong, 0.4–1.2 cm. long, 3–8 mm. broad, lateral wings present, broad and corky, narrowed somewhat at the base, dorsal wings usually absent, occasionally two, smaller and less corky or similar to the lateral wings, oil tubes 5–9 in the intervals, or if the dorsal wings are absent, 18–23 on the dorsal surface, 6–12 on the commissure, sometimes one at the base of the wing, strengthening cells present or absent.

Type specimen: *Newberry* [Mexican Boundary Survey; Little Colorado or Flax River, Long. 111°, Arizona], 3 May 1858 (TYPE in the Gray Herbarium of Harvard University).

Distribution: southern Utah and northern Arizona.

Specimens examined:

Utah: 1872, *Bishop* (US); near the Grand River, Moab, May 1892, *Eastwood* (CH 364675); Moab, on the Grand River, May 1892, *Eastwood* (P 82050); Moab, near the Grand River, May 1892, *Eastwood 3* (US); Westwater, May 1890, *M. E. Jones* (G, US); Cisco, 2 May 1890, *M. E. Jones* (CAL 173332, M, US); Westwater, 6 May 1891, *M. E. Jones* (D 148924); Milford, 5000 ft. alt., 18 June 1880, *M. E. Jones 1792* (C, CH, D, F, G, NY, US); gravel, Silver Reef, 4500 ft. alt., 4 May 1894, *M. E. Jones 5163u* (P, US); La Verken, 3400 ft. alt., 8 May 1894, *M. E. Jones 5196L* (US); 1877, *E. Palmer* (PA); St. George, 1877, *E. Palmer 180* (G, NY, US); near St. George (Valley of the Virgin), 1874, *Parry 83* (C, F, G, M, NY, PA, PAR); Milford, 5000 ft. alt., 10–11 May 1903, *Stokes* (US 505538); Kanab, *Mrs. E. P. Thompson* (G).

Arizona: [Little Colorado or Flax River, Long. 111°], 3 May 1858, *Newberry* (G type); 1872, *W. Thompson* (US).

EXCLUDED SPECIES

C. aboriginum Jones, Contr. West. Bot. 12: 22. 1908 = **Aulospermum aboriginum** (Jones) Mathias, Ann. Mo. Bot. Gard. **17**: 352. 1930.

C. aboriginum Jones var. *oblongus* Jones, Contr. West. Bot. 12: 23. 1908 = **Aulospermum aboriginum** (Jones) Mathias, Ann. Mo. Bot. Gard. **17**: 352. 1930.

C. aboriginum Jones var. *ovalis* Jones, Contr. West. Bot. 12: 22. 1908 = **Aulospermum aboriginum** (Jones) Mathias, Ann. Mo. Bot. Gard. **17**: 352. 1930.

C. aboriginum var. *subternatus* Jones, Contr. West. Bot. 12: 23. 1908 = **Aulospermum aboriginum** (Jones) Mathias, Ann. Mo. Bot. Gard. **17**: 352. 1930.

C. albiflorus (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 624. 1840 = **Pteryxia terebinthina var. albiflora** (Nutt.) Mathias, Ann. Mo. Bot. Gard. **17**: 339. 1930.

C. alpinus Gray, Am. Jour. Sci. II. **33**: 408. 1862 = **Oreoxis alpina** (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 144. 1900.

C. ? anisatus Gray, Proc. Acad. Phila. **1863**: 63. 1864, excl. *Parry no. 157* = **Pseudocymopterus anisatus** (Gray) Coult. & Rose, emend. Mathias, Ann. Mo. Bot. Gard. **17**: 317. 1930.

C. ? anisatus Gray, Proc. Acad. Phila. **1863:** 63. 1864, as to *Parry no. 157* = **Pseudocymopterus Hendersoni** Coult. & Rose, emend. Mathias, Ann. Mo. Bot. Gard. **17:** 321. 1930.

C. Bakeri (Coult. & Rose) Jones, Contr. West. Bot. 12: 28. 1908 = **Oreoxis Bakeri** Coult. & Rose, Contr. U. S. Nat. Herb. **7:** 144. 1900.

C. basalticus Jones, Contr. West. Bot. 12: 16. 1908 = **Aulospermum basalticum** (Jones) Tidestrom, Contr. U. S. Nat. Herb. **25:** 397. 1925. [Fl. Utah & Nev.]

C. bipinnatus Wats. Proc. Am. Acad. **20:** 368. 1885 = **Pseudocymopterus bipinnatus** (Wats.) Coult. & Rose, Rev. N. Am. Umbell. 75. 1888.

C. bulbosus Nels. Bull. Torr. Bot. Club **26:** 241. 1899 = **Phellopterus bulbosus** (Nels.) Coult. & Rose, Contr. U. S. Nat. Herb. **7:** 168. 1900.

C. calcareus Jones, Contr. West. Bot. 8: 32. 1898 = **Pteryxia terebinthina var. calcarea** (Jones) Mathias, Ann. Mo. Bot. Gard. **17:** 334. 1930.

C. californicus (Coult. & Rose) Jones, Contr. West. Bot. 12: 27. 1908 = **Pteryxia terebinthina var. californica** (Coult. & Rose) Mathias, Ann. Mo. Bot. Gard. **17:** 337. 1930.

C. campestris (Nutt.) Torr. & Gray, Fl. N. Am. **1:** 624. 1840 = **Phellopterus montanus** Nutt. acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7:** 167. 1900.

C. cinerarius Gray, Proc. Am. Acad. **6:** 535. 1865, as to Brewer collection from "above Mono Lake" = **Aulospermum aboriginum** (Jones) Mathias, Ann. Mo. Bot. Gard. **17:** 352. 1930.

C. duchesnensis Jones, Contr. West. Bot. 13: 12. 1910 = **Aulospermum duchesnense** (Jones) Tidestrom, Contr. U. S. Nat. Herb. **25:** 397. 1925 [Fl. Utah & Nev.].

C. Elrodi Jones, Bull. Univ. Mont. XV. 61: 41. 1910 = **Pteryxia terebinthina var. foeniculacea** (Nutt.) Mathias, Ann. Mo. Bot. Gard. **17:** 332. 1900.

C. foeniculaceus (Nutt.) Torr. & Gray, Fl. N. Am. **1:** 624. 1840 = **Pteryxia terebinthina var. foeniculacea** (Nutt.) Mathias, Ann. Mo. Bot. Gard. **17:** 332. 1900.

C. glaber (Gray) Black in Hodgson, "Res. Hakodate," 335. 1861, nomen nudum = **Glehnia littoralis** Schmidt, Prol. Fl. Jap. in Miq. Ann. Mus. Bot. Lugd. Bat. **3:** 61. 1867.

C. glaucus Nutt. Jour. Acad. Phila. **7**: 28. 1834 = **Aulospermum glaucum** (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900.

C. glaucus Nutt. acc. to Wats. Bot. King's Exp. 124. 1871, not Nutt. Jour. Acad. Phila. **7**: 28. 1834 = **Aulospermum Watsoni** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900.

C. humboldtensis Jones, Contr. West. Bot. 12: 21. 1908 = **Pseudocymopterus humboldtensis** (Jones) Mathias, Ann. Mo. Bot. Gard. **17**: 325. 1930.

C. ibapensis Jones, Zoe **3**: 302. 1893 = **Aulospermum ibapense** (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900.

C. Jonesii Coult. & Rose, Rev. N. Am. Umbell. 80. 1888 = **Aulospermum Jonesii** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 178. 1900.

C. lapidosus Jones, Contr. West. Bot. 8: 31. 1898 = **Aulospermum longipes** (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 175. 1900.

C. lapidosus var. *deserti* Jones, Contr. West. Bot. 12: 21. 1908 = **Aulospermum longipes** (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 175. 1900.

C. ligusticoides Jones, Contr. West. Bot. 12: 29. 1908 = **Pseudocymopterus montanus** (Gray) Coult. & Rose, Rev. N. Am. Umbell. 74. 1888.

C. ligusticoides var. *tenuifolius* (Gray) Jones, Contr. West. Bot. 12: 29. 1908 = **Pseudocymopterus montanus** (Gray) Coult. & Rose, Rev. N. Am. Umbell. 74. 1888.

C. (*?*) *littoralis* Gray, Mem. Am. Acad. **6**: 391. 1859 = **Glehnia leiocarpa** Mathias, Ann. Mo. Bot. Gard. **15**: 95. 1928.

C. longipes Wats. Bot. King's Exp. 124. 1871 = **Aulospermum longipes** (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 175. 1900.

C. [*ymopteribus*] *macrorhizus* Buckl. Proc. Acad. Phila. **1861**: 455. 1862 = **Phellopterus macrorhizus** (Buckl.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 167. 1900.

"*C. montanus* Nutt. in Torr. & Gray" acc. to Gray, Mem. Am. Acad. N. S. **4**: 56. 1849 [Pl. Fendl.] = **Phellopterus montanus** Nutt. acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 167. 1900.

C. montanus (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 624. 1840 = **Phellopterus montanus** Nutt. acc. to Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 167. 1900.

C. montanus var. *globosus* Wats. Bot. King's Exp. 124. 1871, as to fruit = **Phellopterus purpurascens** (Gray) Coult. & Rose, emend. Mathias, Ann. Mo. Bot. Gard. **17**: 370. 1930.

C. montanus var. *pedunculatus* Jones, Proc. Calif. Acad. Sci. II. **5**: 686. 1895 = **Phellopterus macrorhizus** (Buckl.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 167. 1900.

C. montanus var. *purpurascens* Gray, Bot. Ives' Exp. 15. 1860 = **Phellopterus purpurascens** (Gray) Coult. & Rose, emend. Mathias, Ann. Mo. Bot. Gard. **17**: 370. 1930.

C. ? nevadensis Gray, Proc. Am. Acad. **6**: 536. 1865 = **Podistera nevadensis** (Gray) Wats. Proc. Am. Acad. **22**: 475. 1887.

C. nivalis Wats. Bot. King's Exp. 123. 1871 = **Pseudocymopterus nivalis** (Wats.) Mathias, Ann. Mo. Bot. Gard. **17**: 327. 1930.

C. owenensis Jones, Contr. West. Bot. 12: 26. 1908 = **Tauschia Parishii** (Coult. & Rose) Macbr. Contr. Gray. Herb. N. S. **56**: 32. 1918.

C. panamintensis Coult. & Rose, Contr. U. S. Nat. Herb. **4**: 116. 1893 = **Aulospermum panamintense** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 177. 1900.

C. petraeus Jones, Contr. West. Bot. 8: 32. 1898 = **Pteryxia petraea** (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 172. 1900.

C. plurijugus (Coult. & Rose) Jones, Contr. West. Bot. 12: 25. 1908 = **Rhysopterus plurijugus** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 186. 1900.

C. purpurascens Jones, Proc. Calif. Acad. Sci. II. **5**: 687. 1895, excl. synonym of Gray, not *C. purpurascens* (Gray) Jones, Zoe **4**: 277. 1893 = **Phellopterus multinervatus** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 168. 1900.

C. purpurascens (Gray) Jones, Zoe **4**: 277. 1893, not of Jones, Proc. Calif. Acad. Sci. II. **5**: 687. 1895 = **Phellopterus purpurascens** (Gray) Coult. & Rose, emend. Mathias, Ann. Mo. Bot. Gard. **17**: 370. 1930.

C. purpureus Wats. Am. Nat. **7**: 300. 1873 = **Aulospermum**

purpureum (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 178. 1900.

C. Rosei Jones, Contr. West. Bot. 12: 17, 27. 1908 = **Aulospermum Rosei** Jones in Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 179. 1900.

"*C. terebinthinus* Dougl." acc. to Eaton & Wright, N. Am. Bot. 216. 1840 = **Pteryxia terebinthina** (Hook.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 171. 1900.

C. terebinthinus (Hook.) Torr. & Gray, Fl. N. Am. **1**: 624. 1840 = **Pteryxia terebinthina** (Hook.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 171. 1900.

C. terebinthinus var. *albiflorus* (Nutt.) Jones, Contr. West. Bot. 10: 56. 1902 = **Pteryxia terebinthina** var. **albiflora** (Nutt.) Mathias, Ann. Mo. Bot. Gard. **17**: 339. 1930.

C. terebinthinus var. *californicus* (Coult. & Rose) Jeps. Man. Fl. Pl. Calif. 730. 1925 = **Pteryxia terebinthina** var. **californica** (Coult. & Rose) Mathias, Ann. Mo. Bot. Gard. **17**: 337. 1930.

C. terebinthinus var. *foeniculaceus* Gray, Am. Jour. Sci. II. **33**: 408. 1862, as to *Parry no. 157* = **Pseudocymopterus Hendersoni** Coult. & Rose, emend. Mathias, Ann. Mo. Bot. Gard. **17**: 321. 1930.

C. thaploides Torr. & Gray acc. to Walp. Rep. Bot. Syst. **2**: 418. 1843, err. typ. = **Pteryxia terebinthina** var. **foeniculacea** (Nutt.) Mathias, Ann. Mo. Bot. Gard. **17**: 332. 1930.

C. thapsoides (Nutt.) Torr. & Gray, Fl. N. Am. **1**: 625. 1840 = **Pteryxia terebinthina** var. **foeniculacea** (Nutt.) Mathias, Ann. Mo. Bot. Gard. **17**: 332. 1930.

C. utahensis Jones, Proc. Calif. Acad. Sci. II. **5**: 684. 1895 = **Phellopterus purpurascens** (Gray) Coult. & Rose, emend. Mathias Ann. Mo. Bot. Gard. **17**: 370. 1930.

C. utahensis var. *Eastwoodae* Jones, Proc. Calif. Acad. Sci. II. **5**: 685. 1895 = **Phellopterus bulbosus** (Nels.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 168. 1900.

C. utahensis var. *monocephalus* Jones, Proc. Calif. Acad. Sci. II. **5**: 685. 1895 = **Phellopterus purpurascens** (Gray) Coult. & Rose, emend. Mathias, Ann. Mo. Bot. Gard. **17**: 370. 1930.

C. Watsoni (Coult. & Rose) Jones, Contr. West. Bot. 12: 25. 1908 = **Aulospermum Watsoni** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 176. 1900.

Supplement

8. **A. basalticum** (Jones) Tidestrom, Contr. U. S. Nat. Herb. **25**: 397. 1925 [Fl. Utah & Nev.).[82]

Cymopterus basalticus Jones, Contr. West. Bot. 12: 16, 20. 1908; Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 447. 1909.

Coriophyllus basalticus (Jones) Rydb. Fl. Rocky Mts. 620, 1064. 1917, and ed. 2. 620. 1922.

Plants acaulescent or subcaulescent with the development of an inconspicuous pseudoscape, 0.6–1.2 dm. high, glabrous, bluish-glaucous throughout; leaves ovate-oblong in general outline, excluding the petiole, 0.5–3 cm. long, 1.5–3.5 cm. broad, leaf blade reniform to cordate-oblong in general outline, bi–tri-pinnatisect, primary divisions 3–7, more or less confluent, cuneate to obovate in general outline, secondary divisions inconspicuous, subcuneate, the ultimate segments appearing as acute, mucronate lobes of a broad leaflet, petiole 1–5 cm. long; peduncles usually exceeding the leaves, 3–10 cm. long, umbels several-rayed, rays spreading to reflexed, more or less stout, 5–15 mm. long, secondary rays or pedicels obsolete, involucre absent or rarely present as one or two conspicuous or inconspicuous linear-attenuate, sub-scarious bracts, involucel dimidiate, of several conspicuous, linear to obovate, attenuate, subscarious bracts, entire or lacerate toward the apex, usually equalling or exceeding the yellow or purplish flowers; fruit ovate in general outline, 3–5 mm. long, 3–4 mm. broad, wings well-developed, slightly enlarged toward the base in cross-section, oil tubes 6–8 in the intervals, 8–10 on the commissure, usually 1 in the wing base, seed face slightly concave.

Type specimen: *M. E. Jones*, Half-way station west of WaWa, Utah, 7000 ft. alt., 15 May 1906 (TYPE in the Herbarium of Pomona College).

Distribution: known only from the type locality.

Specimens examined:

UTAH: Half-way station west of WaWa, 7000 ft. alt., 15 May 1906, *M. E. Jones* (P 82199 TYPE, 82198).

[82] Material of this species was obtained too late to be incorporated in the main body of the thesis.

List of Exsiccatae

The distribution numbers are printed in *italics*. The number in parenthesis is the page number on which the specimen is cited. Unnumbered collections are indicated by a dash.

Alcott, W. P. — (392).
Andrews, D. M. — (263).
Anect, Bro. *157*, *279* (274).
Anderson, F. W. — (262, 326); *3047* (262).
Anderson, J. P. — (299, 364).
Anderson, J. R. — (262).
Arsène, Bro. G. *17989* (369).
Arsène, Bro. G. and Bro. A. Benedict, *15456* (274); *15707* (304); *16135* (292).
Austin, Mrs. R. M. —, *72*, *540* (337).
Austin, S. W. *514* (360).
Bailey, V, *12* (386); *574* (304); *631* (292); *1035* (304); *1437* (309); *1974* (350).
Baker, C. F. — (260, 272, 299, 365); [*Patterson 3934*] (388); [*Patterson 3937*] (365); [*Patterson 3988*], *1* (272); *5* (299); *12* (291); *18* (357); *59* (369); *137* (299); *498* (358); *499*, *500* (369); *505* (291); *508*, *789* (299); *847* (285); *856* (291); *859*, *877* (299); *1369* (337).
Baker, C. F., F. S. Earle, and S. M. Tracy, — (299); *137* (300); *577* (291); *619*, *848* (300).
Baker, C. F. and J. M. Holzinger, *4* (272)
Baker, H. P. — (268, 330).
Barber, E. A. — (300).
Barber, H. S. *73* (309).
Barlow, B. — (304).
Bartholomew, E. *8738* (335).
Bates, J. M. — (262, 268, 364, 386); *562* (259); *5895* (364); *5915* (386).
Beals, Mrs. W. G. — (373).
Beardslee, H. C. *125* (300).
Bearsall, J. *810* (351).
Beattie, R. K. — (285).
Beckwith, E. G. — (381).
Beckwith, F. *149* (300).
Benedict, Bro. A. *2402* (392).
Bennitt, D. *37* (342).
Bergman, H. F. — (262); *1589* (386).
Berthoud, E. L. — (272).
Bessey, C. E. — (268).
Bessey, C. E. and H. J. Webber, — (268).
Bessey, E. A. — (288, 300, 318).
Bethel, E. — (272, 279, 365, 388); *22* (369); *23* (357); *36–1* (388); *36–3* (365); *36–4* (323); *36–5* (300); *36–7*, *36–8* (285); *36–11* (279); *36–12*, *36–13* (272); *36–18* (300).
Bethel, E. and I. W. Clokey, *4222* (272); *4228* (279).
Bigelow, J. M. — (280, 304); *419* (304).
Biltmore Herbarium, *1* [*302*] (300).
Bishop, F. M. — (347, 358, 394); *25* (346); *27* (357); *29* (373).
Blankinship, J. W. — (262, 326, 335, 387); *16* (387); *23*, *28*, *217* (262); *218* (265); *225* (326); *226* (335).
Blumer, J. C. — (288); *1365*, *1366* (309); *1822* (304); *3315* (309).
Bodin, J. E. — (364).
Bolander, H. N. —, *6345* (337).
Bolander, H. N. and A. Kellogg, — (337).
Bourgeau, E. — (260).
Bradbury, J. — (259, 386); *100* (386).
Brandegee, K. — (337, 353, 380).
Brandegee, T. S. — (272, 365, 388); *43*, *B 43*, *B 44* (365); *800* (333); *803* (330); *953* (300); *954* (318); *955* (291); *956* (285); *958* (300).
Brendel, F. *232* (370).
Breninger, G. F. *3* (300).
Brewer, W. H. — (372); *1739* (254); *1825* (353); *1899* (378); *1988* (337); *2717* (254).
Brewster, L. J. — (391).
Brode, M. D. *1*, *5* (333).
Brown, C. L. — (381).
Brown, H. E. — (337).
Brown, R. H. — (333).
Brumbach, F. M. and C. A. Davies *104b* (288); *105* (300).
Buckley, S. B. — (367).
Burglehaus, F. H. — (263).
Bush, B. F. *610* (367).
Butler, B. T. *5048* (326).

Canby, W. M. — (272, 279, 288, 300, 318, 389); *147* (351); *148* (326); *154* (262).
Carleton, M. A. — (279).
Carlson, J. I. — (373).
Carr, W. P. *6* (386).
Cary, M. *34* (267); *301* (272).
Chesnut, V. K. and W. W. Jones, *164* (335).
Churchill, J. R. — (288, 300, 318, 388).
Clemens, Mrs. J. — (254, 323, 346, 347).
Clemens, M. S. — (337).
Clement, *521* (387).
Clements, F. — (288, 318); *182* (300); *211* (318).
Clements, F. C. — (318).
Clements, F. E. — (300).
Clements, F. E. and E. S. *94* (318); *235*, *298*, *431.1* (300); *435*, *513* (288).
Clokey, I. W. *3041* (388); *3264* (300); *4224* (272); *4227* (263).
Clos, W. C. *10* (347); *56* (307).
Cockerell, T. D. A. — (292, 304, 369); *25* (292).
Cockerell, T. D. A. and W. P. — (304).
Cockerell, Mrs. T. D. A. — (392).
Cod, B. S. *514* (386).
Coghill, G. E. *3* (304).
Congdon, J. W. — (254).
Cooper, W. S. *11* (300); *14* (272); *42* (300); *45*, *59* (272); *116* (300); *122* (285); *156* (273); *202* (300); *252* (285); *261* (273); *275* (285).
Copeland, I. — (3 8).
Cottam, W. P. *1055* (372); *2039* (358); *2227*, *2425* (307); *3925* (358); *4245* (307); *4647*, *4744* (358).
Cottam, W. P. and Hutchings, *2295* (307).
Cotton, J. S. *957* (333); *1080* (330).
Coulter, J. M. — (273, 285, 300, 388).
Coville, F. V. *554* (334).
Coville, F. V. and F. Funston, *508*, *545*, *739* (360); *1392* (338).
Cowdry, N. H. [*101224*] (387).
Cowen, J. H. — (264, 273, 285, 388); *27* (273); *184* (388); *186*, *262* (285); *1402*, *1405*, *1407* (273).
Crandall, C. S. — (260, 264, 273, 279, 285, 301, 365, 388); *4* (273); *6*, *7* (301); *9* (388); *11* (301); *13* (391); *27* (286); *31* (301); *32* (365); *188* (273); *254* (279) *258* (388); *266* (301); *1366*, *1369* (388); *1374* (279); *1386*, *1388* (301); *1435* (286); *1438*, *1439* (264).
Crandall, C. S. and J. H. Cowen, — (301)
Cross, W. *55* (301).
Curtis, C. C. — (301).
Cusick, W. C. *1255* (342); *1396*, *1651*, *1657* (334); *1995* (342); *2040a* (327); *2085*, *2443a*, *2627* (334).
Daniels, F. *145* (279); *157* (273).
Darlington, H. T. *245* (333).
Davidson, A. —, *161*, *161a* (317); *2075*, *2087* (338).
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ABBREVIATIONS

The following abbreviations have been used in citations to indicate the different herbaria from which material has been obtained for study:

A = Herbarium of the New York State Museum, Albany.
B = Herbarium of the Brooklyn Botanic Garden.
BYU = Herbarium of Brigham Young University, Provo, Utah.
C = Herbarium of the Carnegie Museum, Pittsburgh.
CAL = Herbarium of the University of California.
CAN = National Herbarium of Canada.
CAS = Herbarium of the California Academy of Sciences.
CH = Herbarium of the University of Chicago, deposited in the Field Museum of Natural History.

D = Dudley Herbarium of Leland Stanford, Jr. University.
F = Herbarium of the Field Museum of Natural History.
G = Gray Herbarium of Harvard University.
GO = Herbarium of G. J. Goodman, Missouri Botanical Garden.
IAC = Herbarium of the Iowa Agricultural College.
J = Herbarium of M. E. Jones, Claremont, California.
K = Herbarium of the Royal Botanic Gardens, Kew.
M = Herbarium of the Missouri Botanical Garden.
MU = Herbarium of the University of Minnesota.
N = Edward L. Greene Herbarium of Notre Dame University.
NEV = Herbarium of the Nevada Agricultural Experiment Station.
NY = Herbarium of the New York Botanical Garden.
O = Herbarium of the University of Oregon.
P = Herbarium of Pomona College.
PA = Herbarium of the Academy of Natural Sciences, Philadelphia.
PAR = Parry Herbarium deposited in the Iowa Agricultural College.
R = Rocky Mountain Herbarium of the University of Wyoming.
UC = Herbarium of the University of Colorado.
US = United States National Herbarium.
WSC = Herbarium of the State College of Washington.

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Explanation of Plate

PLATE 21

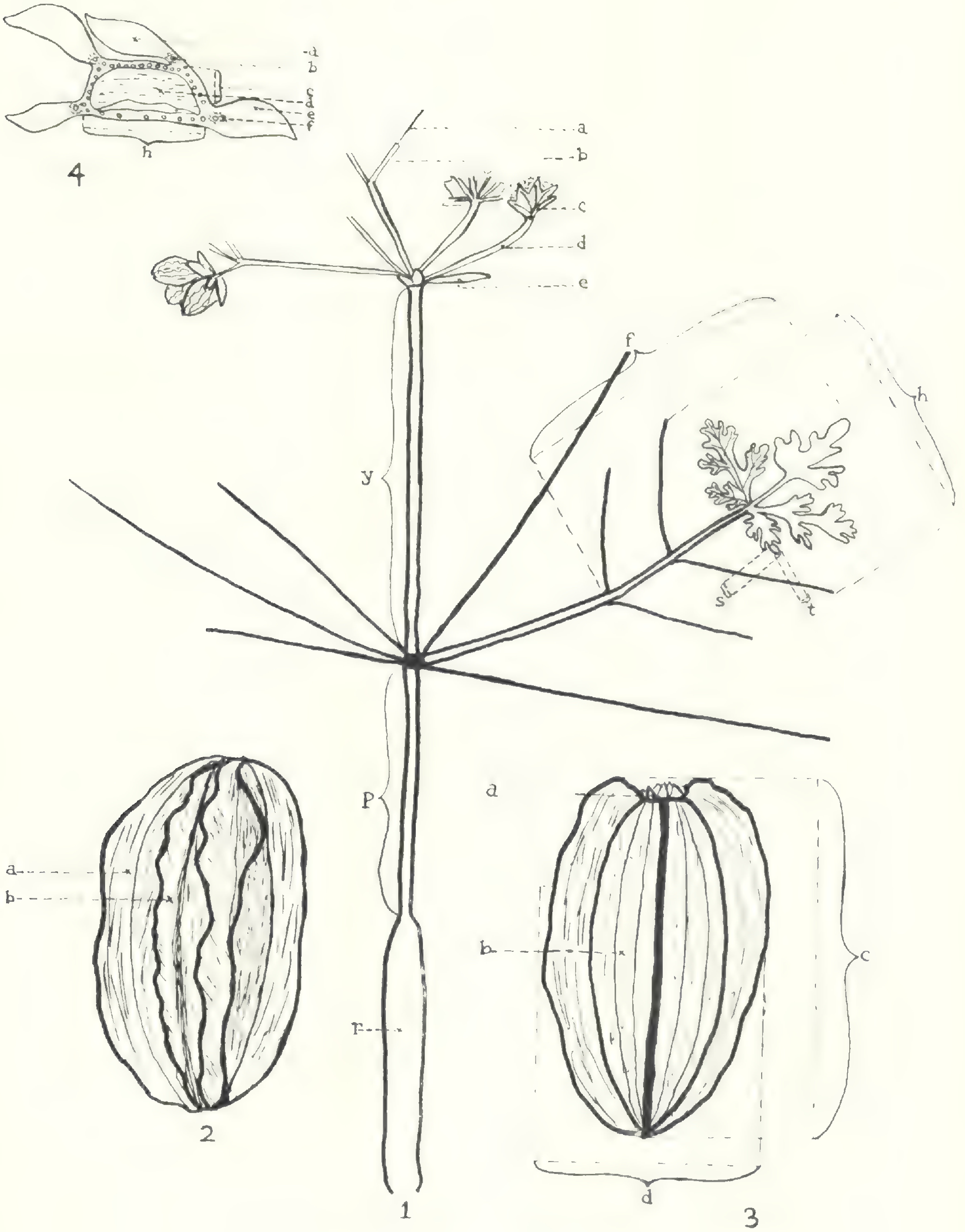
Composite diagram illustrating the morphological characters used in a classification of the various genera.

Fig. 1. Diagram of a complete plant; *a*, carpophore; *b*, pedicel or secondary ray; *c*, involucel; *d*, primary ray; *e*, involucral bract; *f*, leaf-blade length; *h*, leaf-blade width; *p*, pseudoscape; *r*, root; *s*, ultimate-segment length; *t*, ultimate-segment breadth; *y*, peduncle.

Fig. 2. Dorsal surface of a typical mericarp; *a*, lateral wing; *b*, dorsal wing.

Fig. 3. Ventral or commissural surface of a typical mericarp; *a*, persistent calyx teeth; *b*, commissural surface showing longitudinal striations marking the position of oil tubes and the carpophore; *c*, fruit length; *d*, fruit breadth.

Fig. 4. Cross-section in the median plane of a typical mericarp showing the position of oil tubes around the seed, etc.; *a*, dorsal wing; *b*, accessory oil tube at the wing-base; *c*, interval between the wings; *d*, seed; *e*, lateral wing; *f*, strengthening tissue at the wing-base—collenchyma or vascular elements; *h*, commissural surface.



MATHIAS—STUDIES IN UMBELLIFERAE

EXPLANATION OF PLATE

PLATE 22

Microphotographs of cross-sections in the median plane of the fruit, illustrating the various genera. × 12.

Fig. 1. *Podistera nevadensis* (Gray) Wats. Collected at Mt. Dana, California, July 1902, *Hall & Babcock 3607* (Missouri Botanical Garden Herbarium).

Fig. 2. *Neoparrya lithophila* Mathias. Collected on rocks, Huerfano Mts., New Mexico, 1867, *Parry 83* (Missouri Botanical Garden Herbarium), isotype.

Fig. 3. *Musineon tenuifolium* (Nutt.) Coult & Rose. Collected in Laramie Hills, Albany Co., Wyoming, July 1903, *A. Nelson 8977* (Missouri Botanical Garden Herbarium).

Fig. 4. *Aletes acaulis* (Torr.) Coult. & Rose. Collected at Castle Rock, Colorado, 1 July–9 Sept. 1885, *Patterson 37* (Missouri Botanical Garden Herbarium).

Fig. 5. *Rhysopterus plurijugus* Coult. & Rose. Collected in Malheur Valley, near Harper Ranch, Oregon, 10 June 1896, *Leiberg 2240* (U. S. National Herbarium), type.

Fig. 6. *Oreoxis alpina* (Gray) Coult. & Rose. Collected in Colorado Territory, 1872, *Parry* (Missouri Botanical Garden Herbarium).

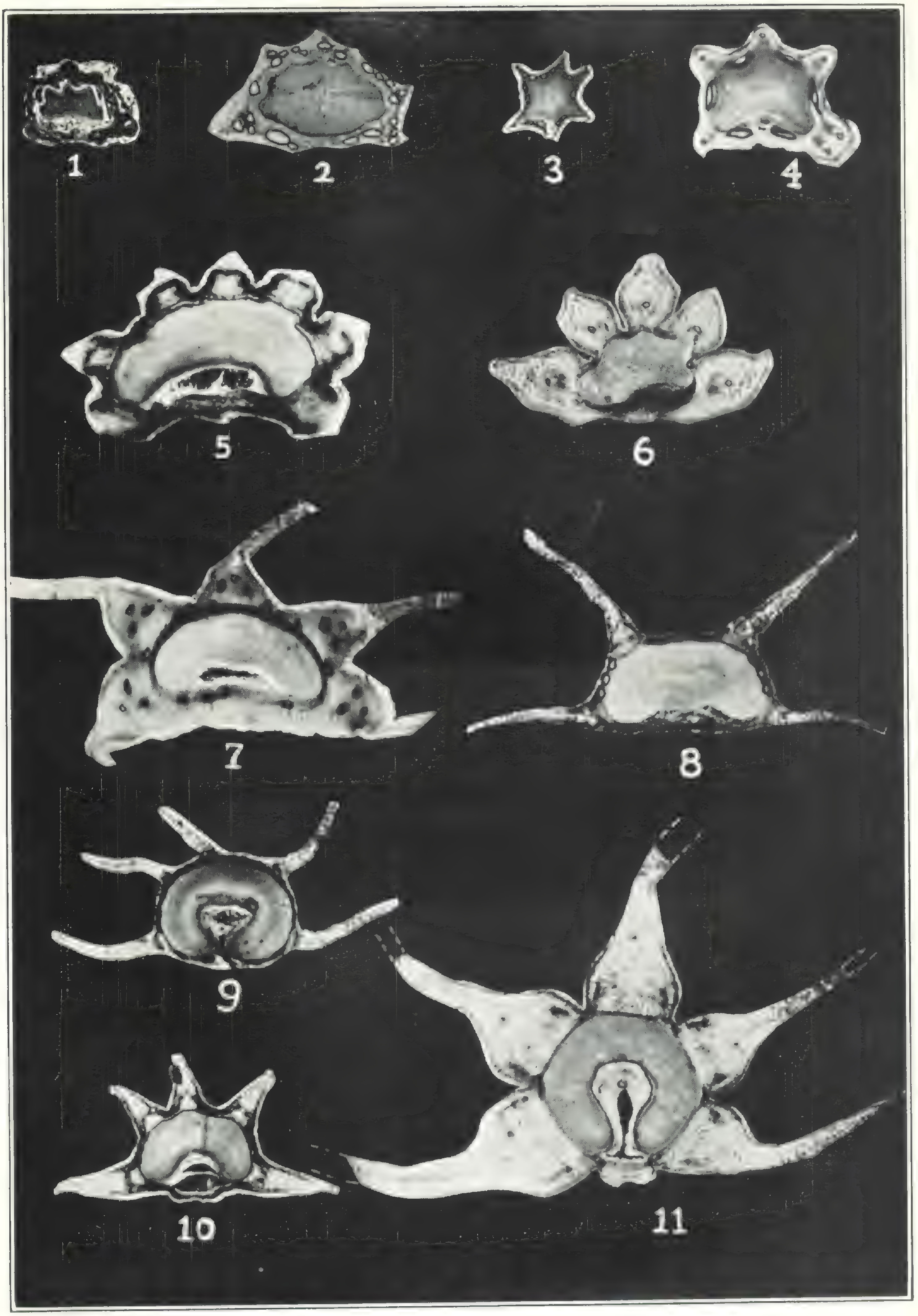
Fig. 7. *Phellopterus montanus* Nutt. Collected at Fort Collins, Colorado, 20 May 1896, *C. F. Baker* (Missouri Botanical Garden Herbarium).

Fig. 8. *Phellopterus macrorhizus* (Buckl.) Coult. & Rose. Collected at Dallas, Texas, 10 April 1900, *Reverchon 2008a* (Missouri Botanical Garden Herbarium).

Fig. 9. *Aulospermum longipes* (Wats.) Coult. & Rose. Collected at Sandy, Utah, 24 May 1895, *M. E. Jones* (Missouri Botanical Garden Herbarium).

Fig. 10. *Pseudocymopterus bipinnatus* (Wats.) Coult. & Rose. Collected in Bridger Mts., and Trail Creek, Park Co., Montana, 29 June–2 July 1899, *Blankinship 225* (Missouri Botanical Garden Herbarium).

Fig. 11. *Aulospermum Jonesii* Coult. & Rose. Collected at Frisco, Utah, 22 June 1880, *M. E. Jones 1808* (Missouri Botanical Garden Herbarium), cotype.



MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 23

Microphotographs of cross-sections in the median plane of the fruit of *Cymopterus*. × 12.

Fig. 1. *C. cinerarius* Gray, emend. Mathias. Collected in the Mono National Forest, Nevada, 19 Aug. 1912, *Holton & Maule* (U. S. National Herbarium 583073).

Fig. 2. *C. globosus* Wats. Collected at Carson City, Nevada, 29 May 1897, *M. E. Jones* (Missouri Botanical Garden Herbarium).

Fig. 3. *C. deserticola* Brandg. Collected at Kramer, California, May 1913, *K. Brandegee* (Herbarium of the University of California 173143), type.

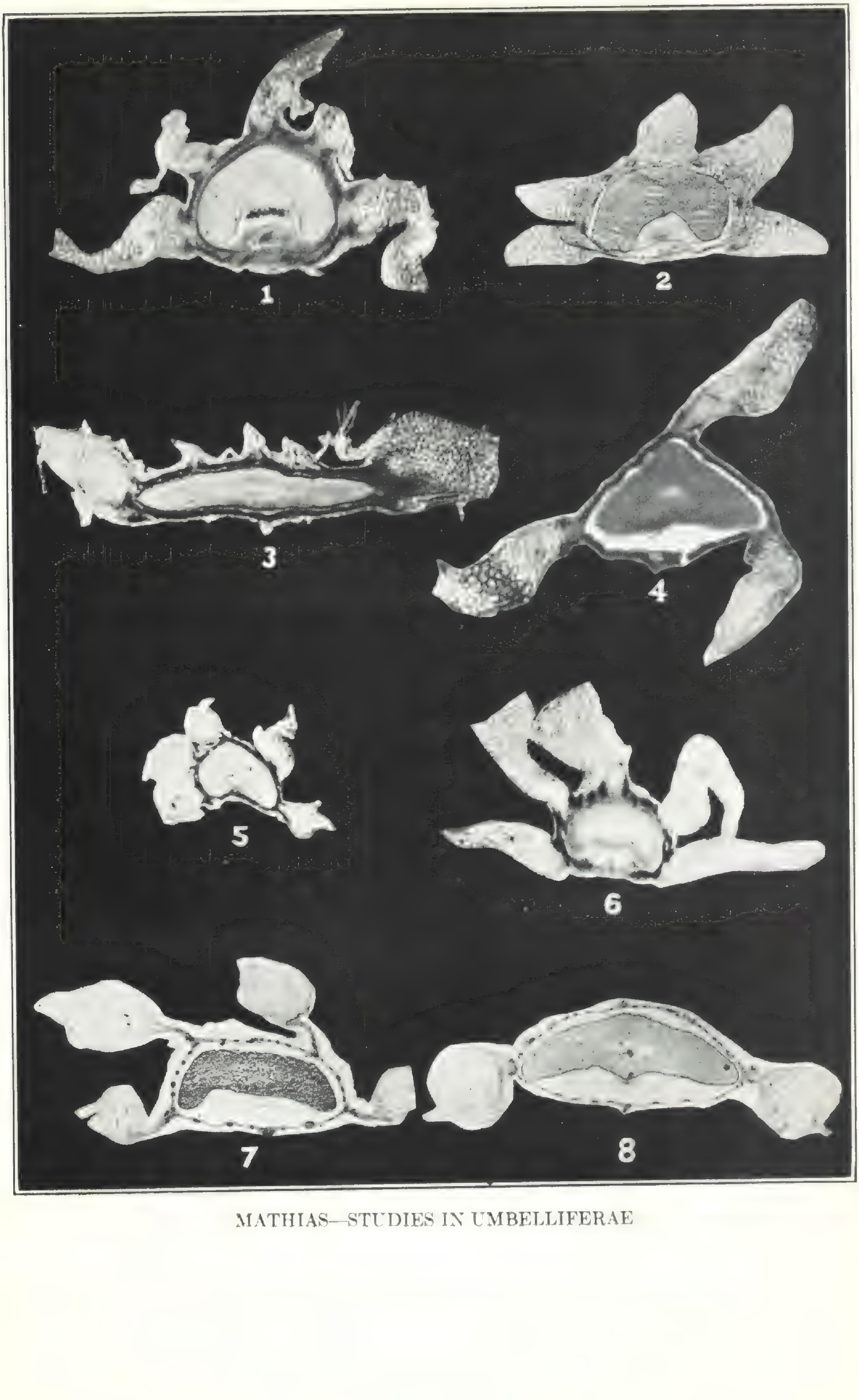
Fig. 4. *C. megacephalus* Jones. Collected at Little Colorado, N. Arizona, 10 June 1890, *M. E. Jones* (U. S. National Herbarium 47080), type.

Fig. 5. *C. corrugatus* Jones. Collected at Humboldt Lake, Nevada, 17 June 1882, *M. E. Jones 3886* (U. S. National Herbarium).

Fig. 6. *C. Coulteri* (Jones) Mathias. Collected at Sevier Bridge, Utah, 26 April 1910, *M. E. Jones* (Herbarium of Pomona College 82077).

Fig. 7. *C. Fendleri* Gray. Collected at Cisco, Utah, 2 May 1890, *M. E. Jones* (Missouri Botanical Garden Herbarium).

Fig. 8. *C. Newberryi* (Wats.) Jones. Collected at St. George, Utah, 1877, *E. Palmer 180* (Gray Herbarium).



MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 24

Cross-sections in the median plane of the mature fruit of *Cymopterus*. × 6.

Figs. 1–14. *C. Fendleri* Gray, showing the variation within the species.

Fig. 1. Collected at Grand Junction, Colorado, 22 May 1895, *M. E. Jones* (Herbarium of Pomona College 82247).

Fig. 2. Collected at DeBeque, Mesa Co., Colorado, 19 May 1911, *Osterhout 4487* (Herbarium of Pomona College).

Fig. 3. Collected at Green River, Utah, 23 May 1914, *M. E. Jones* (Herbarium of Pomona College 83096).

Fig. 4. Collected at San Rafael Swell, Utah, 19 May 1914, *M. E. Jones* (Herbarium of Pomona College 83099).

Fig. 5. Collected at San Rafael Swell, Utah, 8 May 1914, *M. E. Jones* (Herbarium of Pomona College 83098).

Fig. 6. Collected at San Rafael Swell, Utah, 28 May 1914, *M. E. Jones* (Herbarium of Pomona College 83100).

Fig. 7. Collected at McElmo Creek, Utah, *Eastwood* (Herbarium of Pomona College 82241).

Fig. 8. Collected at La Bajada, New Mexico, 15 May 1926, *Benedict 2402* (U. S. National Herbarium).

Fig. 9. Collected in Sandia Mts., near Madera, New Mexico, *Ellis 263* (U. S. National Herbarium).

Fig. 10. Collected at La Bajada, New Mexico, 15 May 1926, *Benedict 2402* (U. S. National Herbarium).

Fig. 11. Collected in Sandia Mts., near Madera, New Mexico, *Ellis 263* (U. S. National Herbarium).

Fig. 12. Collected at Grand Falls, Cascade of the Little Colorado, Arizona, 13 May 1901, *Ward* (U. S. National Herbarium 410080).

Fig. 13. Collected at Holbrook, Arizona, 18 June 1901, *Ward* (U. S. National Herbarium 410081).

Fig. 14. Collected at X Ranch, 18 miles north of Holbrook, Arizona, May 1901, *W. Hough 104* (U. S. National Herbarium).

Fig. 15. *C. cinerarius* Gray, emend. Mathias. Collected in the Mono National Forest, Nevada, 19 Aug. 1912, *Holton & Maule* (U. S. National Herbarium 583073).

Fig. 16. *C. globosus* Wats. Collected at Reno, Nevada, 12 May 1896, *Hillman* (Herbarium of Pomona College 82070).

Fig. 17. *C. megacephalus* Jones. Collected at Little Colorado, N. Arizona, 10 June 1890, *M. E. Jones* (U. S. National Herbarium 47080), type.

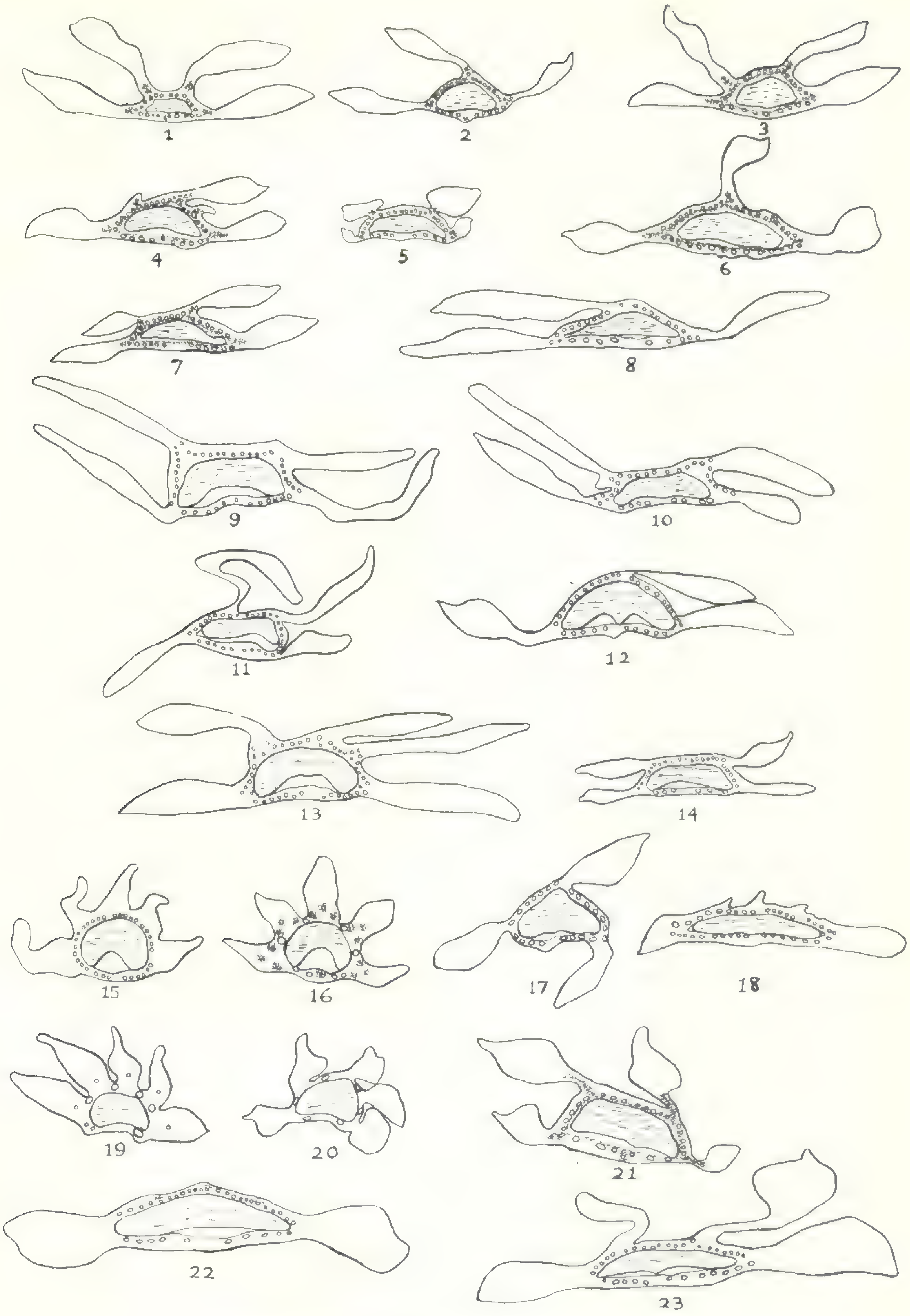
Fig. 18. *C. deserticola* Brandg. Collected at Kramer, California, May 1913, *K. Brandegee* (Herbarium of the University of California 173143), type.

Fig. 19. *C. Coulteri* (Jones) Mathias. Collected at Sevier Bridge, Utah, 26 April 1910, *M. E. Jones* (Herbarium of Pomona College 82077).

Fig. 20. *C. corrugatus* Jones. Collected at Humboldt Lake, Nevada, 17 June 1882, *M. E. Jones 3886* (U. S. National Herbarium).

Fig. 21. *C. acaulis* (Pursh) Raf. Collected in the "R. Mts.," *Nuttall* (Herbarium of the Academy of Natural Sciences, Philadelphia).

Figs. 22–23. *C. Newberryi* (Wats.) Jones. Collected at Moab, Utah, May 1892, *Eastwood 3* (U. S. National Herbarium).



MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 25

Fig. 1. Cross-section of the pseudoscape of *Aulospermum longipes* (Wats.) Coult. & Rose. × 4½.

Fig. 2. Cross-section of a portion of the mericarp of *Cymopterus Newberryi* (Wats.) Jones, showing the oil tubes and strengthening tissue at the base of an aborted wing. × 45.

Fig. 3. Cross-section of a fruit of *Cymopterus Newberryi* (Wats.) Jones, showing the variation in wing structure in the two mericarps. × 8.

Figs. 4–13. Cross-sections in the median plane of the mature mericarp of *Pseudocymopterus montanus* (Gray) Coult. & Rose, indicating the variation within the species. × 6.

Fig. 4. Collected at Tie City, Albany Co., Wyoming, 20 July 1900, *A. Nelson 7667* (Herbarium of Pomona College).

Fig. 5. Collected at Coppermine Creek, New Mexico, 1851, *Wright 1107* (Gray Herbarium).

Fig. 6. Collected at Continental Divide, New Mexico, 2 Aug. 1892, *Wooton* (U. S. National Herbarium 737584).

Fig. 7. Collected at Sandia Mts., New Mexico, Oct. 1853–4, *Bigelow* (Gray Herbarium).

Fig. 8. Collected at Panguitch Lake, Utah, 7 Sept. 1894, *M. E. Jones 6015x* (U. S. National Herbarium).

Fig. 9. Collected at Bromide Pass, Utah, 27 July 1894, *M. E. Jones 5695t* (U. S. National Herbarium).

Fig. 10. Collected near Pagosa Peak, Colorado, Aug. 1899, *C. F. Baker 508* (Missouri Botanical Garden Herbarium).

Fig. 11. Collected at San Francisco Mts., Arizona, 26 Aug. 1889, *Knowlton 120* (U. S. National Herbarium).

Fig. 12. Collected at Williams, Arizona, 8–25 July 1903, *Griffiths 4930* (U. S. National Herbarium).

Fig. 13. Collected near Flagstaff, Arizona, 23 Aug. 1922, *H. C. Hanson A215* (Missouri Botanical Garden Herbarium).

Fig. 14. Cross-section in the median plane of the mature mericarp of *Pseudocymopterus Davidsoni* (Coult. & Rose) Mathias. × 6. Collected at Clifton, Arizona, 1900, *Davidson 161a* (Missouri Botanical Garden Herbarium).

Figs. 15–16. Cross-sections in the median plane of the mature mericarp of *Pseudocymopterus anisatus* (Gray) Coult. & Rose, emend. Mathias. × 6.

Fig. 15. Collected in the Rocky Mountains, Colorado, 1862, *Hall & Harbour 222* (Missouri Botanical Garden Herbarium), cotype.

Fig. 16. Collected at Minnehaha, Colorado, 16 June–22 July 1901, *Clements & Clements 94* (Missouri Botanical Garden Herbarium).

Figs. 17–18. Cross-section in the median plane of the mature mericarp of *Pseudocymopterus Hendersoni* Coult. & Rose, emend. Mathias. × 6.

Fig. 17. Collected at Teton Mts., Wyoming, 16 Aug. 1899, *Nelson & Nelson 6507* (U. S. National Herbarium).

Fig. 18. Collected at Teton Mts., Wyoming, 16 Aug. 1899, *Nelson & Nelson 6507* (Missouri Botanical Garden Herbarium).

Fig. 19. Cross-section in the median plane of the mature mericarp of *Pseudocy-*

Explanation of Plate

PLATE 25 (Continued)

mopterus humboldtensis (Jones) Mathias. × 10. Collected in the East Humboldt Mts., Nevada, 2 Aug. 1901, *M. E. Jones* (Rocky Mountain Herbarium 113462), cotype.

Figs. 20–21. Cross-sections in the median plane of the mature mericarp of *Pteryxia terebinthina* (Hook.) Coult. & Rose. × 6.

Fig. 20. Collected at Umatilla, Oregon, 1 June 1905, *M. E. Jones* (Missouri Botanical Garden Herbarium).

Fig. 21. Collected near Boardman, Morrow Co., Oregon, 14 June 1928, *J. W. Thompson 4778* (Missouri Botanical Garden Herbarium).

Figs. 22–23. Cross-sections in the median plane of the mature mericarp of *Pteryxia terebinthina* var. *californica* (Coult. & Rose) Mathias. × 6.

Fig. 22. Collected in the Sierra Nevada Mts., California, 1875, *J. G. Lemmon* (U. S. National Herbarium 44683).

Fig. 23. Collected at Little Summit near Butte Meadows, Butte Co., California, 22 June 1914, *A. A. Heller* (Missouri Botanical Garden Herbarium 748222).

Figs. 24–26. Cross-sections in the median plane of the mature mericarp of *Pteryxia terebinthina* var. *foeniculacea* (Nutt.) Mathias. × 6.

Fig. 24. Collected in the Blue Mts., Washington, 4 July 1892, *Lake & Hull 535* (Gray Herbarium).

Fig. 25. Collected at Wallowa Mountains, Oregon, 23 Aug. 1898, *Cusick 2085* (Herbarium of the University of Minnesota).

Fig. 26. Collected at Wallowa Mountains, Oregon, 23 Aug. 1898, *Cusick 2085* (U. S. National Herbarium).

Fig. 27. Cross-section in the median plane of the mature mericarp of *Pteryxia terebinthina* var. *albiflora* (Nutt.) Mathias. × 10. Collected at Red Lodge, Montana, 26 July 1893, *Rose 48* (U. S. National Herbarium).

Figs. 28–29. Cross-sections in the median plane of the mature mericarp of *Pteryxia terebinthina* var. *calcarea* (Jones) Mathias. × 6.

Fig. 28. Collected in Bridger Mts., Montana, 26 May, 17 July 1905, *Blankinship 226* (Missouri Botanical Garden Herbarium).

Fig. 29. Collected at head of Powder River, Big Horn Co., Wyoming, 19 July 1901, *Goodding 322* (U. S. National Herbarium).

Figs. 30–31. Cross-sections in the median plane of the mature fruit of *Pteryxia petraea* (Jones) Coult. & Rose. × 6.

Fig. 30. Collected at Martin, Blaine Co., Idaho, 5 July 1916, *Macbride & Payson 3053* (Missouri Botanical Garden Herbarium).

Fig. 31. Collected at Alvord Desert, Oregon, 30 June 1896, *Leiberg 2426* (Gray Herbarium).

Fig. 32. Cross-section in the median plane of the mature mericarp of *Aulospermum panamintense* var. *acutifolium* Coult. & Rose. × 6. Collected at Newberry's Spring, Mojave Desert, California, May 1884, *Lemmon & Lemmon* (University of California Herbarium 335930), cotype.

Fig. 33. Cross-section in the median plane of the mature mericarp of *Aulospermum panamintense* Coult. & Rose. × 6. Collected at Argus Mts., California, June 1897, *Purpus 5393* (Missouri Botanical Garden Herbarium).

Fig. 34. Cross-section in the median plane of the mature mericarp of *Aulospermum*

Explanation of Plate

PLATE 25 (Continued)

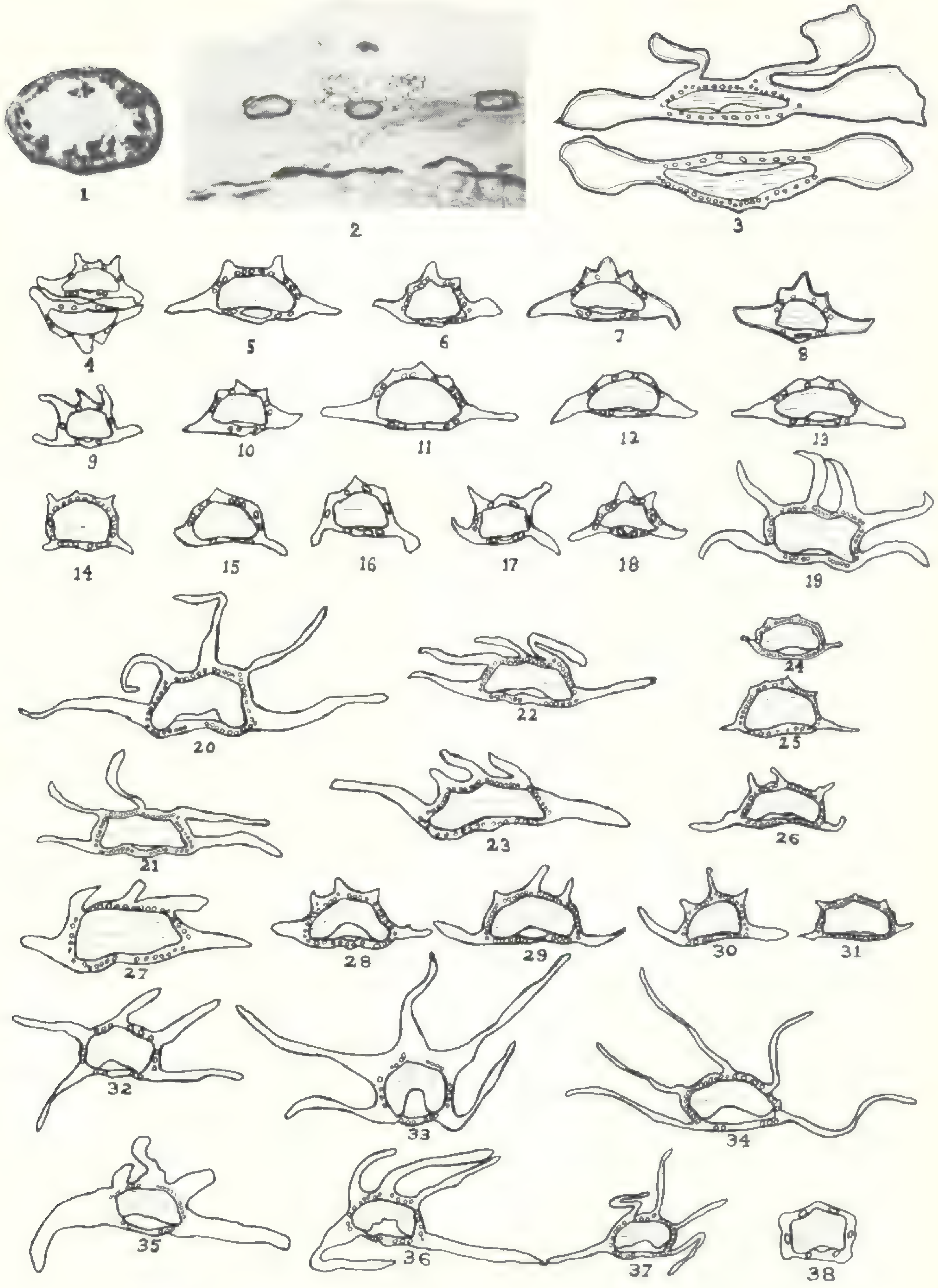
duchesnense (Jones) Tidestrom. × 6. Collected at Myton, Utah, 20 May 1908, *M. E. Jones* (Rocky Mountain Herbarium 113304), cotype.

Fig. 35. Cross-section in the median plane of the mature mericarp of *Aulospermum minimum* Mathias. × 6. Collected at Cedar Breaks, Utah, 17 July 1930, *Goodman & Hitchcock 1591* (Missouri Botanical Garden Herbarium).

Fig. 36. Cross-section in the median plane of the mature mericarp of *Aulospermum Rosei* Jones. × 6. Collected at Richfield, Utah, 18 June 1898, *M. E. Jones 30* (U. S. National Herbarium), type.

Fig. 37. Cross-section in the median plane of the mature mericarp of *Aulospermum aboriginum* (Jones) Mathias. × 6. Collected at Bishop, Owen's Valley, California, 15 May 1897, *M. E. Jones* (Herbarium of Pomona College 82033).

Fig. 38. Cross-section in the median plane of the mature mericarp of *Aletes humilis* Coult. & Rose. × 6. Collected at Dale Creek, Larimer Co., Colorado, 19 July 1899, *Osterhout* (U. S. National Herbarium 361576).



MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 26

Fig. 1. *Musineon divaricatum* (Pursh) Raf. From authentic material, *Forwood 144*, in the Missouri Botanical Garden Herbarium.

Fig. 2. *Musineon tenuifolium* (Nutt.) Coult. & Rose. From typical material, *A. Nelson 8977*, in the Missouri Botanical Garden Herbarium.

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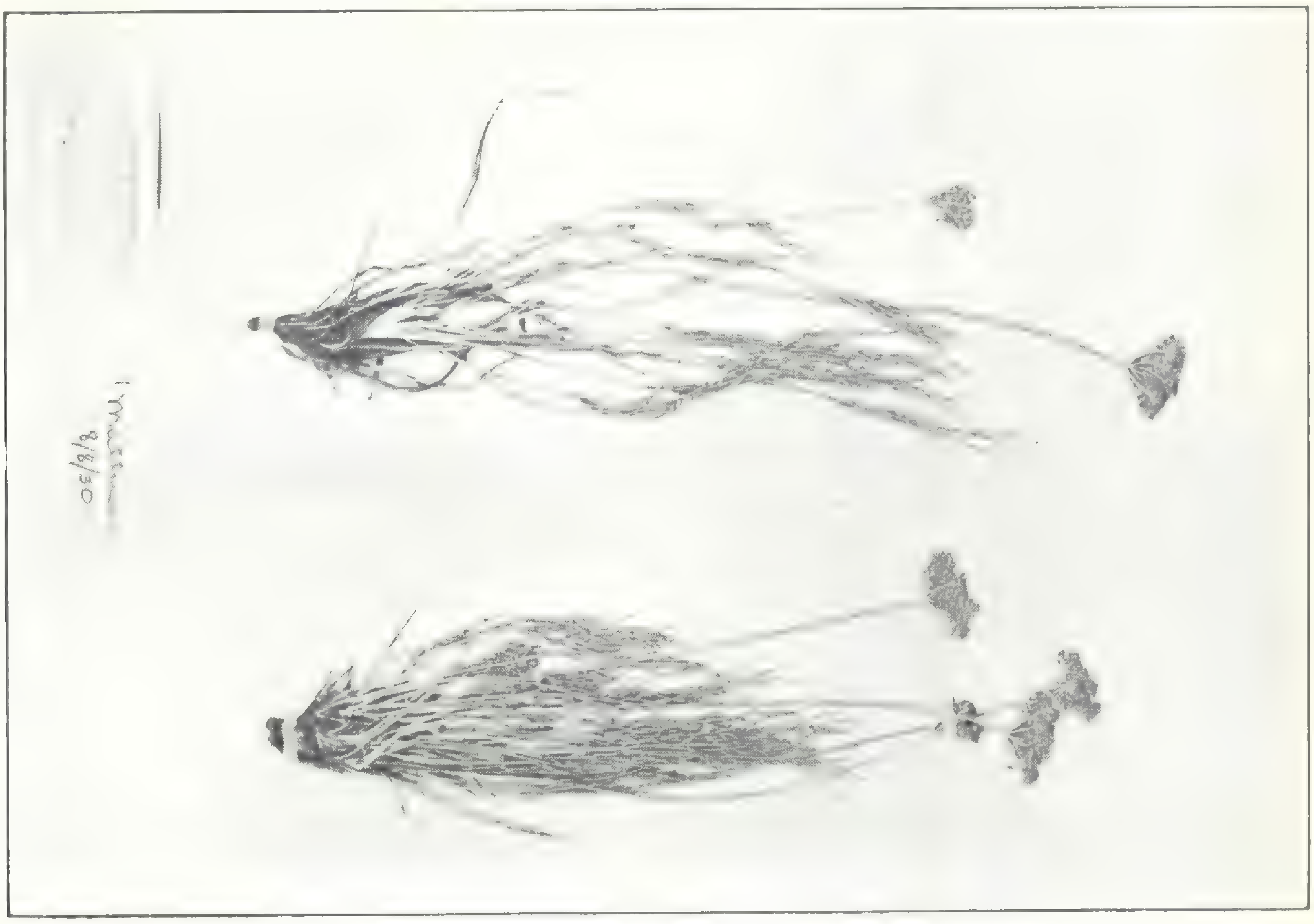

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 27

Fig. 1. *Rhysopterus plurijugus* Coult. & Rose. From the type specimen, *Leiberg 2240*, in the United States National Herbarium.

Fig. 2. *Harbouria trachypleura* (Gray) Coult. & Rose. From a cotype specimen, *Hall and Harbour 215*, in the Missouri Botanical Garden Herbarium.

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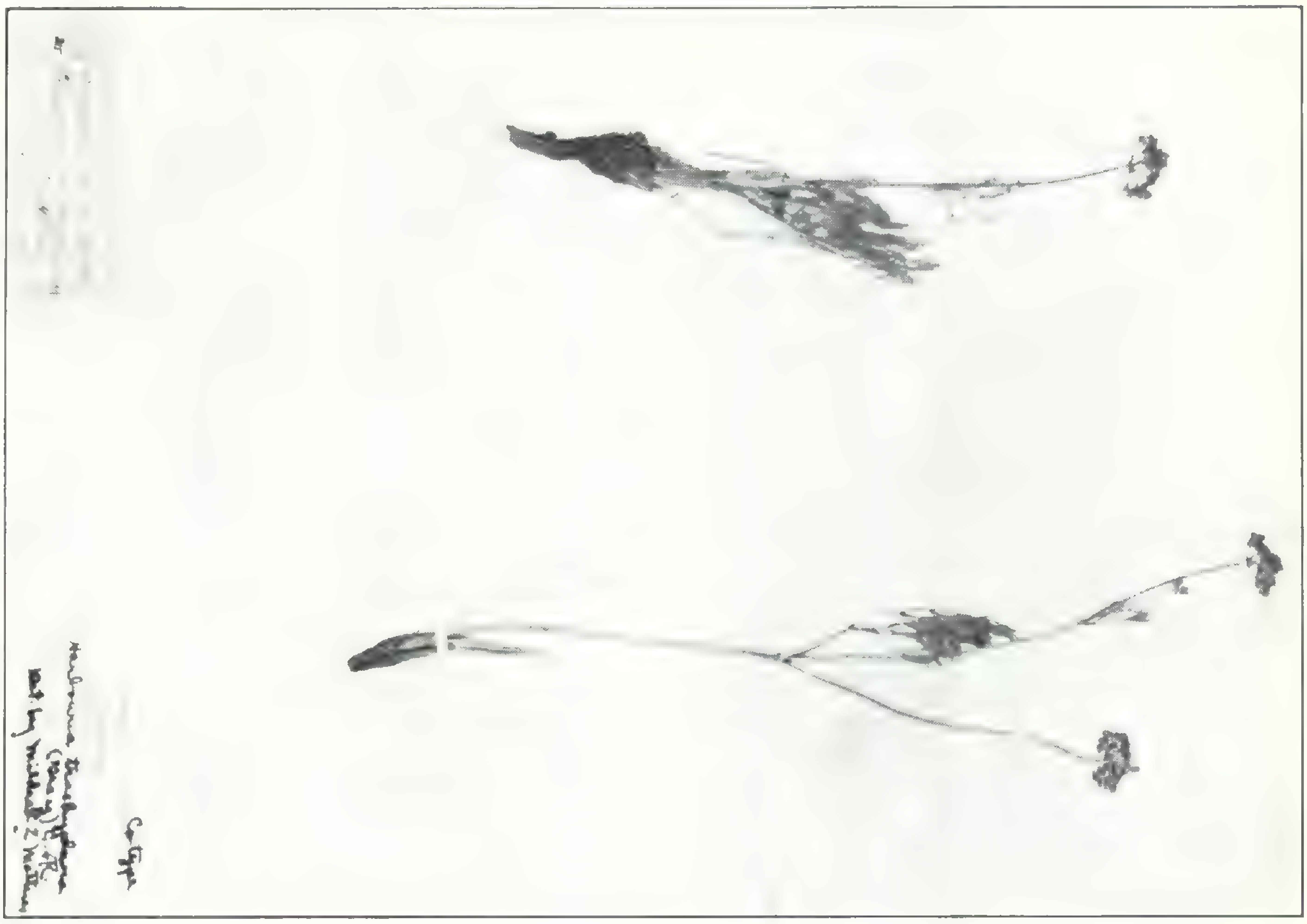

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 28

Fig. 1. *Aletes acaulis* (Torr.) Coult. & Rose. From typical material, *Patterson 37*, in the Missouri Botanical Garden Herbarium.

Fig. 2. *Aletes humilis* Coult. & Rose. From a cotype specimen, *Osterhout 6*, in the Herbarium of the New York Botanical Garden.

1

2

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 29

Fig. 1. *Oreoxis alpina* (Gray) Coult. & Rose. From the type specimen, *Parry 158*, *Hall and Harbour 213*, and *Vasey 221*, in the Gray Herbarium of Harvard University.

Fig. 2. *Oreoxis Bakeri* Coult. & Rose. From the type specimen, *Baker 12*, in the United States National Herbarium.

1

2

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 30

Fig. 1. *Oreoxis MacDougali* (Coult. & Rose) Rydb. From a cotype specimen, *MacDougal 192*, in the Gray Herbarium of Harvard University.

Fig. 2. *Phellopterus multinervatus* Coult. & Rose. From typical material, showing the scarious involucre and involucel, *Eastwood 8188*, in the Herbarium of the California Academy of Sciences.

1

2

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 31

Fig. 1. *Phellopterus bulbosus* (Nels.) Coult. & Rose. From the type specimen, *A. Nelson 4709*, in the Rocky Mountain Herbarium of the University of Wyoming.

Fig. 2. *Phellopterus bulbosus* (Nels.) Coult. & Rose. From a specimen illustrating the elongated peduncle form, *Eastwood*, in the United States National Herbarium (type of *Cymopterus utahensis* var. *Eastwoodae* Jones).

These two specimens illustrate the habital variations within the species.

1

2

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 32

Fig. 1. *Pseudocymopterus montanus* (Gray) Coult. & Rose. From the type specimen, *Fendler 276*, in the Gray Herbarium of Harvard University.

Fig. 2. *Pseudocymopterus montanus* (Gray) Coult. & Rose. From representative material, *Wright 1107*, in the Gray Herbarium of Harvard University (type of *Thaspium montanum* var. *tenuifolium* Gray).

These two specimens illustrate the two extremes in foliar variation which occur in the species. All intermediate forms exist, two of which are illustrated by the following plate.

1

2

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 33

Fig. 1. *Pseudocymopterus montanus* (Gray) Coult. & Rose. From typical material, *A. Nelson 7667*, in the Rocky Mountain Herbarium of the University of Wyoming (type of *Pseudocymopterus sylvaticus* Nels.).

Fig. 2. *Pseudocymopterus montanus* (Gray) Coult. & Rose. From typical material, *J. G. Lemmon 392*, in the United States National Herbarium (type of *Peucedanum Lemmoni* Coult. & Rose).

These two specimens and those illustrated by the preceding plate serve to indicate the great foliar variation occurring in this species. These two specimens are representative of those elements in which there is a tendency toward the complete or partial abortion of dorsal wings.

1

2

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 34

Fig. 1. *Pseudocymopterus Davidsoni* (Coult. & Rose) Mathias. From the type specimen, *Davidson 161a*, in the United States National Herbarium.

Fig. 2. *Pseudocymopterus bipinnatus* (Wats.) Coult. & Rose. From the type specimen, *Hayden 14*, *Canby 148*, and *Watson 158*, in the Gray Herbarium of Harvard University.

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MATHIAS—STUDIES IN UMBELLIFERAE

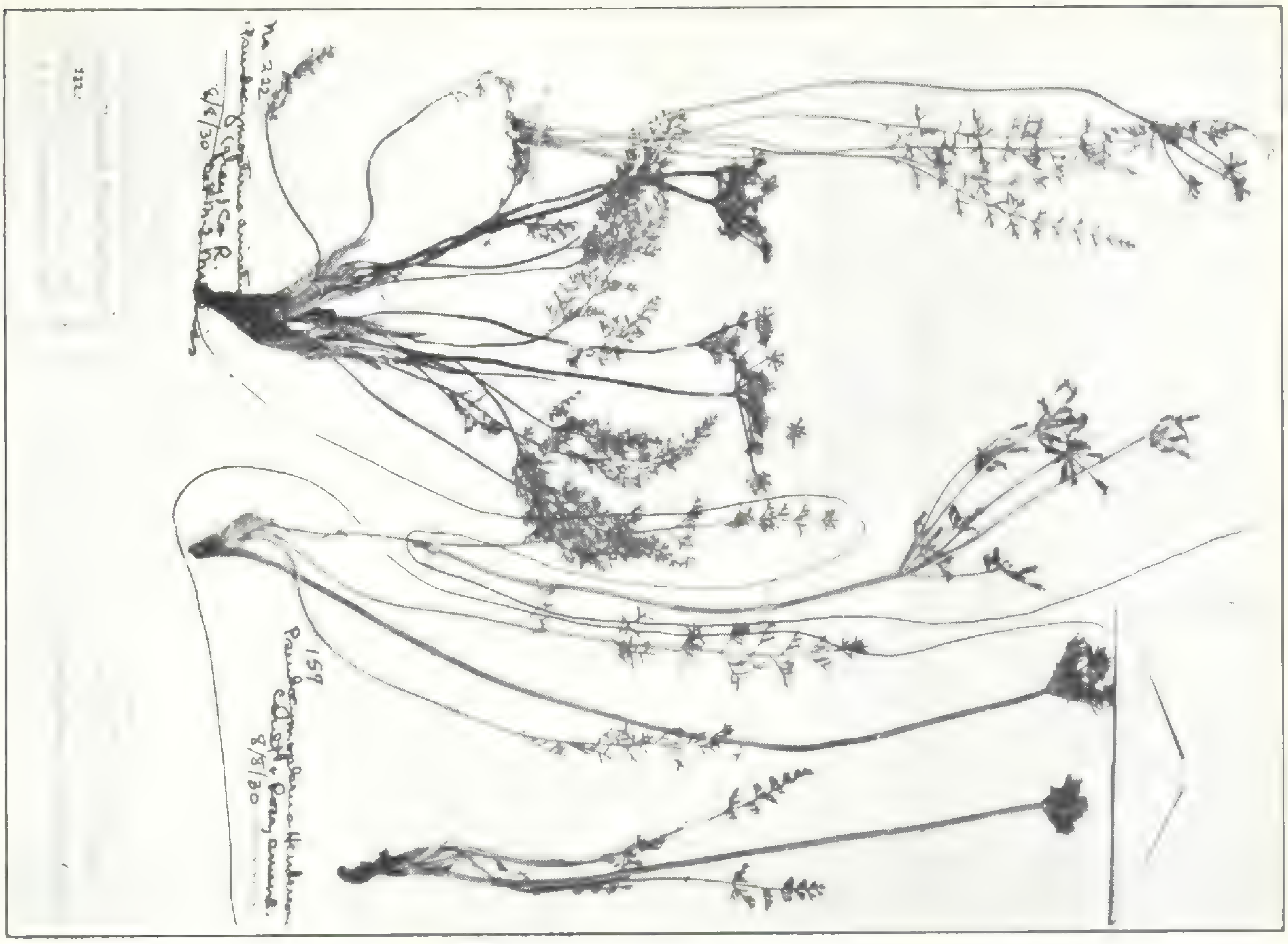
Explanation of Plate

PLATE 35

Fig. 1. *Pseudocymopterus anisatus* (Gray) Coult. & Rose, emend. Mathias. From the type specimen, *Hall and Harbour 222*, in the Gray Herbarium of Harvard University.

Pseudocymopterus Hendersoni Coult. & Rose, emend. Mathias. From typical material, *Parry 157*, in the Gray Herbarium of Harvard University.

Fig. 2. *Pseudocymopterus anisatus* (Gray) Coult. & Rose, emend. Mathias. From typical material, *Clements and Clements 94*, in the Herbarium of the New York Botanical Garden (type of *Pseudopteryxia aletifolia* Rydb.).



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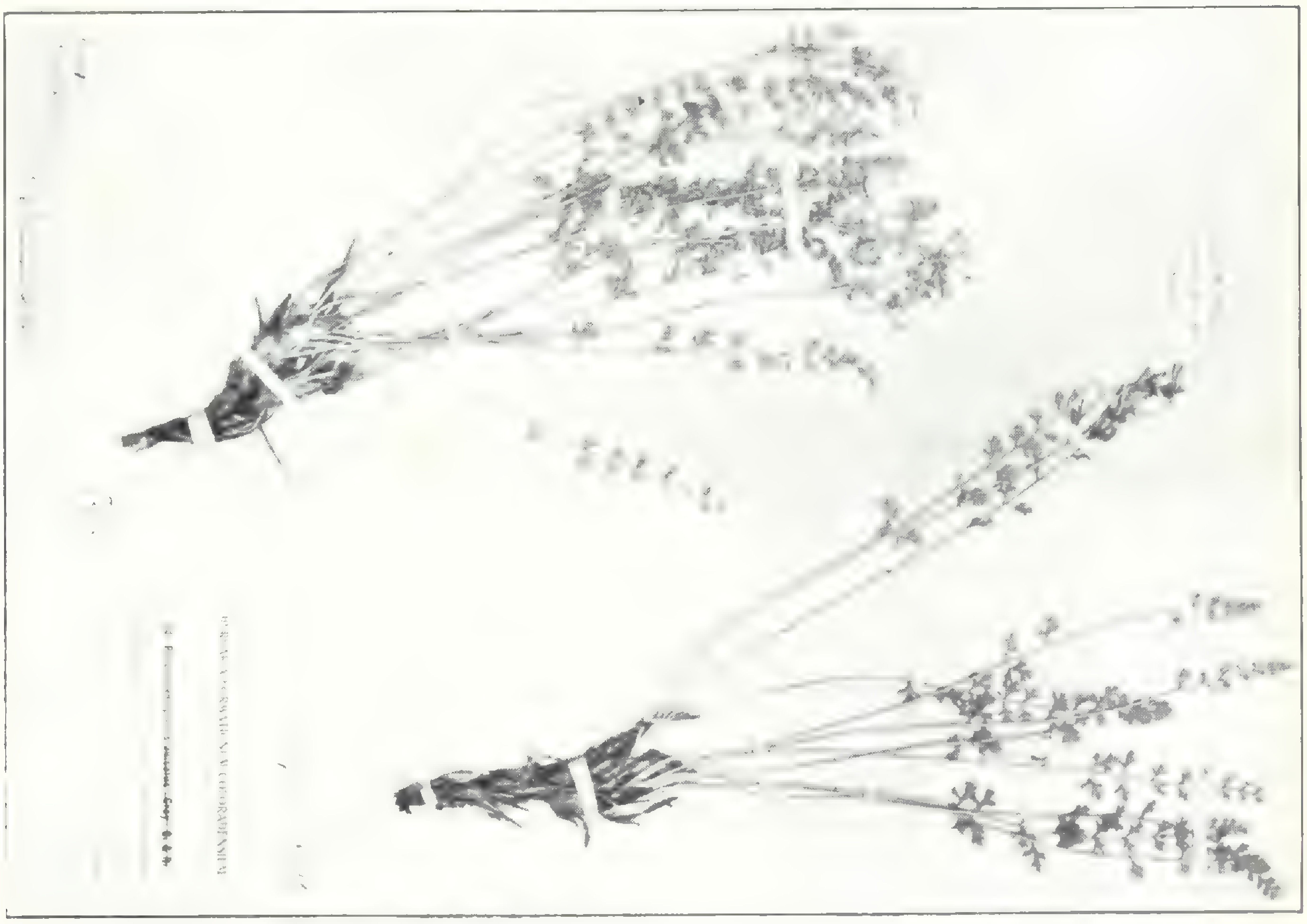

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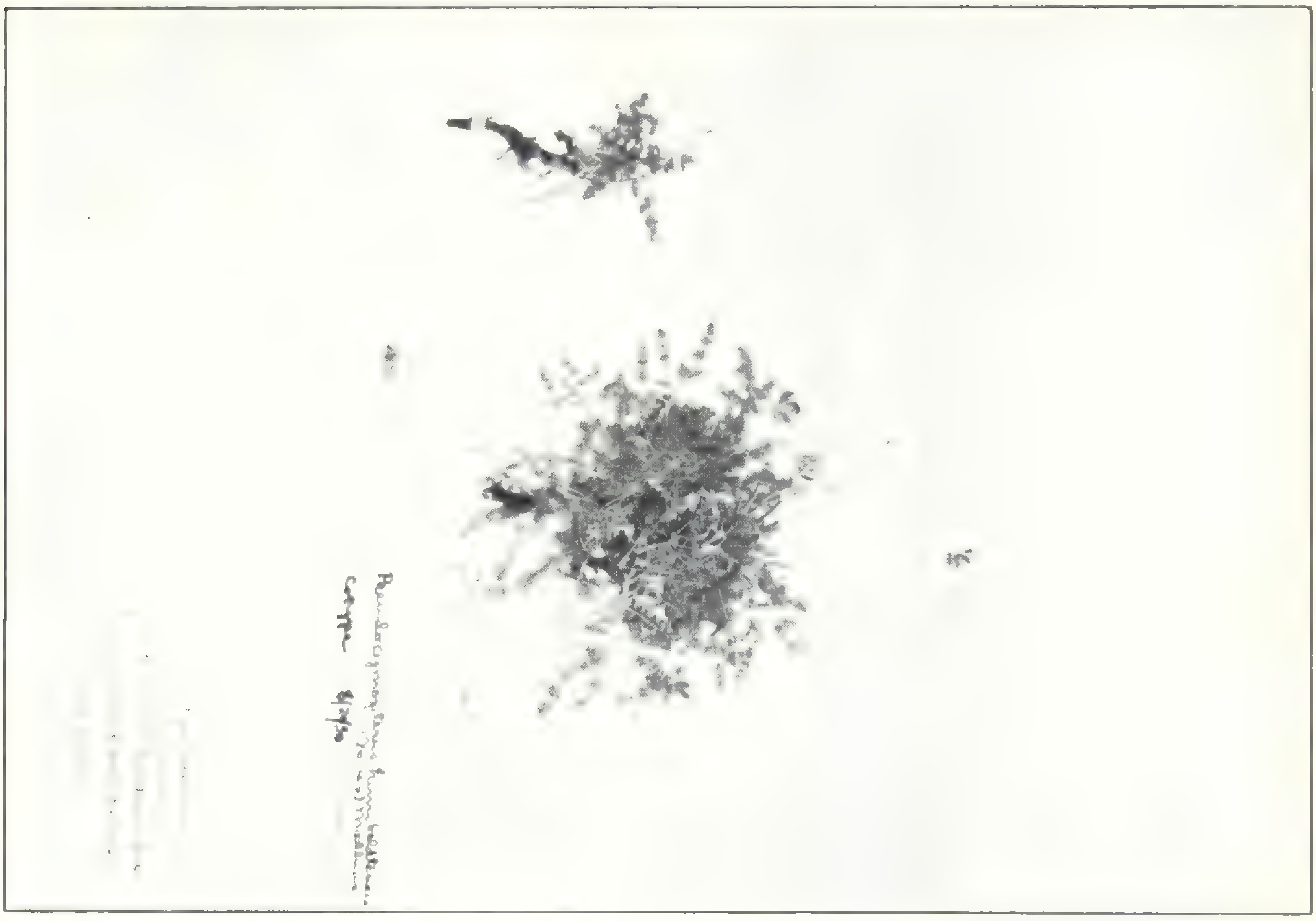
MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 36

Fig. 1. *Pseudocymopterus humboldtensis* (Jones) Mathias. From a cotype specimen, *M. E. Jones*, in the Herbarium of the New York Botanical Garden.

Fig. 2. *Pseudocymopterus nivalis* (Wats.) Mathias. From a cotype specimen, *Watson 448*, in the Gray Herbarium of Harvard University.



MATHIAS—STUDIES IN UMBELLIFERAE

1

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Explanation of Plate

PLATE 37

Fig. 1. *Pteryxia terebinthina* (Hook.) Coult. & Rose. From typical material, *M. E. Jones*, in the Missouri Botanical Garden Herbarium.

Fig. 2. *Pteryxia terebinthina* var. *californica* (Coult. & Rose) Mathias. From the type specimen, *H. E. Brown*, in the United States National Herbarium.

1

2

MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 38

Fig. 1. *Pteryxia terebinthina* var. *calcarea* (Jones) Mathias. From a cotype specimen, *M. E. Jones*, in the United States National Herbarium.

Fig. 2. *Pteryxia petraea* (Jones) Coult. & Rose. From a cotype specimen, *M. E. Jones*, in the Herbarium of the New York Botanical Garden.

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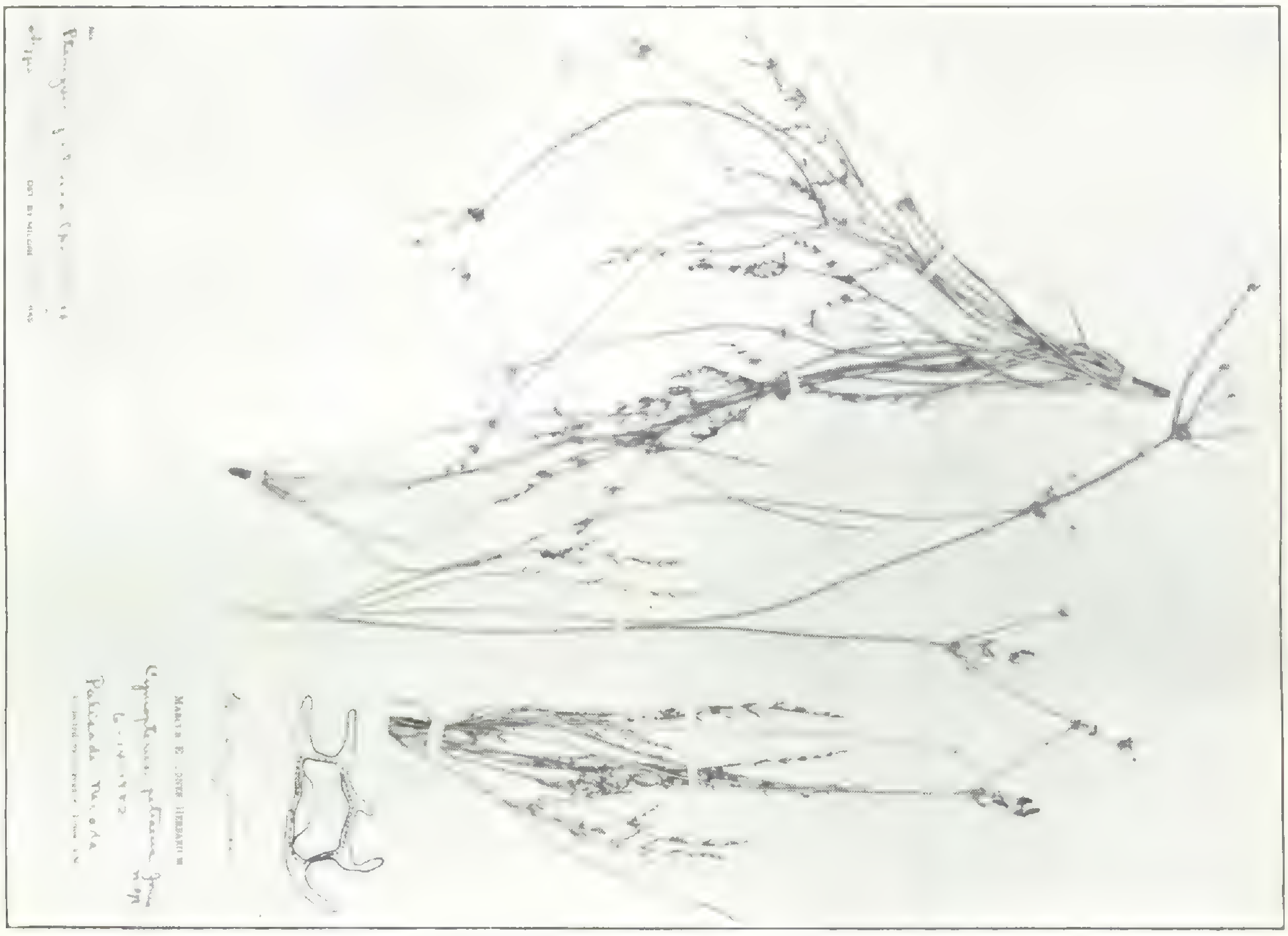

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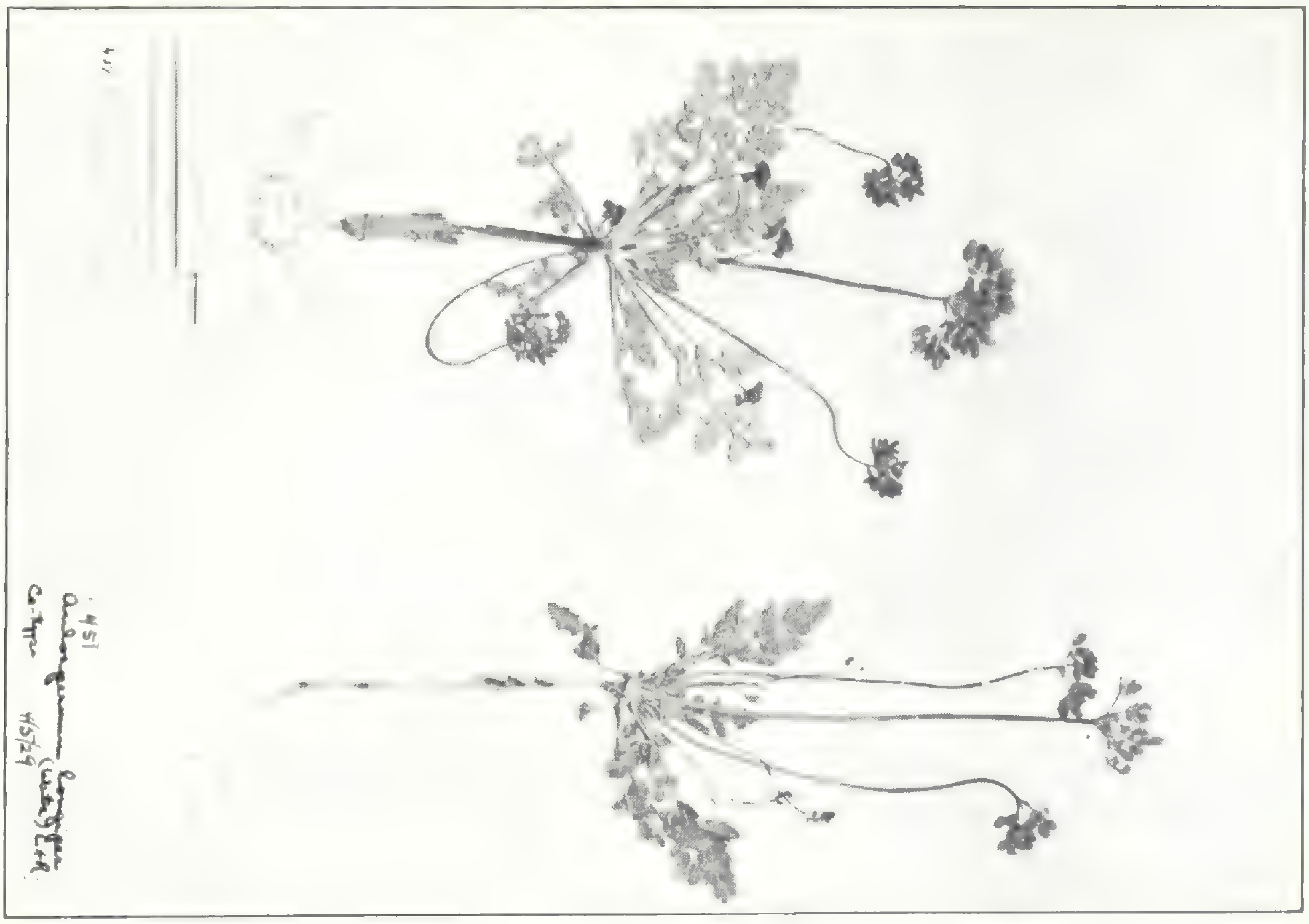
MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 39

Fig. 1. *Aulospermum longipes* (Wats.) Coult. & Rose. From a cotype specimen, *Watson 451*, in the Gray Herbarium of Harvard University.

Fig. 2. *Aulospermum longipes* (Wats.) Coult. & Rose. From a typical specimen showing the pseudoscape, *A. Nelson 4574*, in the Missouri Botanical Garden Herbarium.



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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 40

Fig. 1. *Aulospermum ibapense* (Jones) Coult. & Rose. From the type specimen, *M. E. Jones*, in the United States National Herbarium.

Fig. 2. *Aulospermum Watsoni* Coult. & Rose. From a cotype specimen, *Watson 450*, in the Gray Herbarium of Harvard University.

Aulospermum glaucum (Nutt.) Coult. & Rose. From the type (?) specimen, *Nuttall*, and *Canby 147*, in the Gray Herbarium of Harvard University.

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 41

Fig. 1. *Aulospermum planosum* Osterh. From a cotype specimen, *Osterhout 2572*, in the United States National Herbarium.

Fig. 2. *Aulospermum minimum* Mathias. From the type specimen, *Mathias 723*, in the Missouri Botanical Garden Herbarium.

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 42

Fig. 1. *Aulospermum duchesnense* (Jones) Tidestrom. From a cotype specimen, *M. E. Jones*, in the Herbarium of the California Academy of Sciences.

Fig. 2. *Aulospermum Rosei* Jones. From the type specimen, *M. E. Jones 30*, in the United States National Herbarium.

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 43

Fig. 1. *Aulospermum aboriginum* (Jones) Mathias. From the type specimen, *M. E. Jones*, in the Herbarium of Pomona College.

Fig. 2. *Aulospermum aboriginum* (Jones) Mathias. From typical material, *M. E. Jones*, in the Herbarium of Pomona College (type of *Cymopterus aboriginum* var. *subternatus* Jones).

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 44

Fig. 1. *Aulospermum Jonesii* Coult. & Rose. From a cotype specimen, *M. E. Jones 1808*, in the Missouri Botanical Garden Herbarium.

Fig. 2. *Aulospermum panamintense* Coult. & Rose. From the type specimen, *Coville and Funston 508*, in the United States National Herbarium.

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 45

Fig. 1. *Cymopterus cinerarius* Gray, emend. Mathias. From the type specimen, *Brewer 1899*, in the Gray Herbarium of Harvard University.

Aulospermum aboriginum (Jones) Mathias. From typical material, *Brewer 1825*, in the Gray Herbarium of Harvard University.

Fig. 2. *Cymopterus cinerarius* Gray, emend. Mathias. From typical material, *Holton and Maule*, in the United States National Herbarium.

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 46

Fig. 1. *Cymopterus megacephalus* Jones. From the type specimen, *M. E. Jones*, in the United States National Herbarium.

Fig. 2. *Cymopterus deserticola* Brandg. From the type specimen, *K. Brandegee*, in the Herbarium of the University of California.

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 47

Fig. 1. *Cymopterus globosus* Wats. From typical material, *M. E. Jones*, in the Herbarium of Pomona College.

Fig. 2. *Cymopterus Newberryi* (Wats.) Jones. From the type specimen, *Newberry, Parry 83*, and *Mrs. E. P. Thompson*, in the Gray Herbarium of Harvard University.

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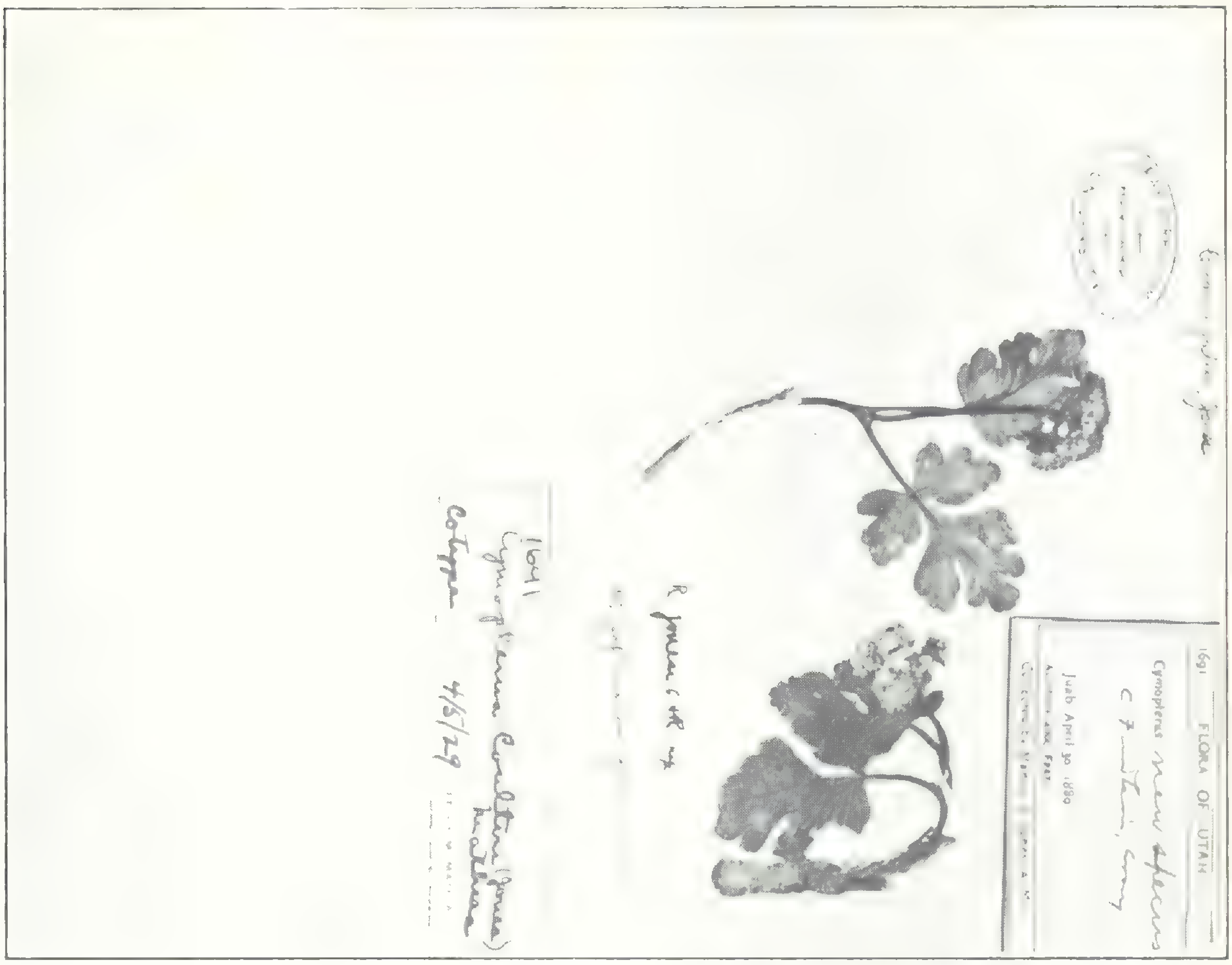
MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 48

Fig. 1. *Cymopterus Coulteri* (Jones) Mathias. From a cotype specimen, *M. E. Jones 1691*, in the Gray Herbarium of Harvard University.

Fig. 2. *Cymopterus Coulteri* (Jones) Mathias. From typical fruiting material, *M. E. Jones*, in the Herbarium of Pomona College.



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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 49

Fig. 1. *Cymopterus corrugatus* Jones. From the type specimen, *M. E. Jones 3886*, in the United States National Herbarium.

Fig. 2. *Cymopterus corrugatus* Jones. From typical material, *H. Engelmann*, in the Missouri Botanical Garden Herbarium.

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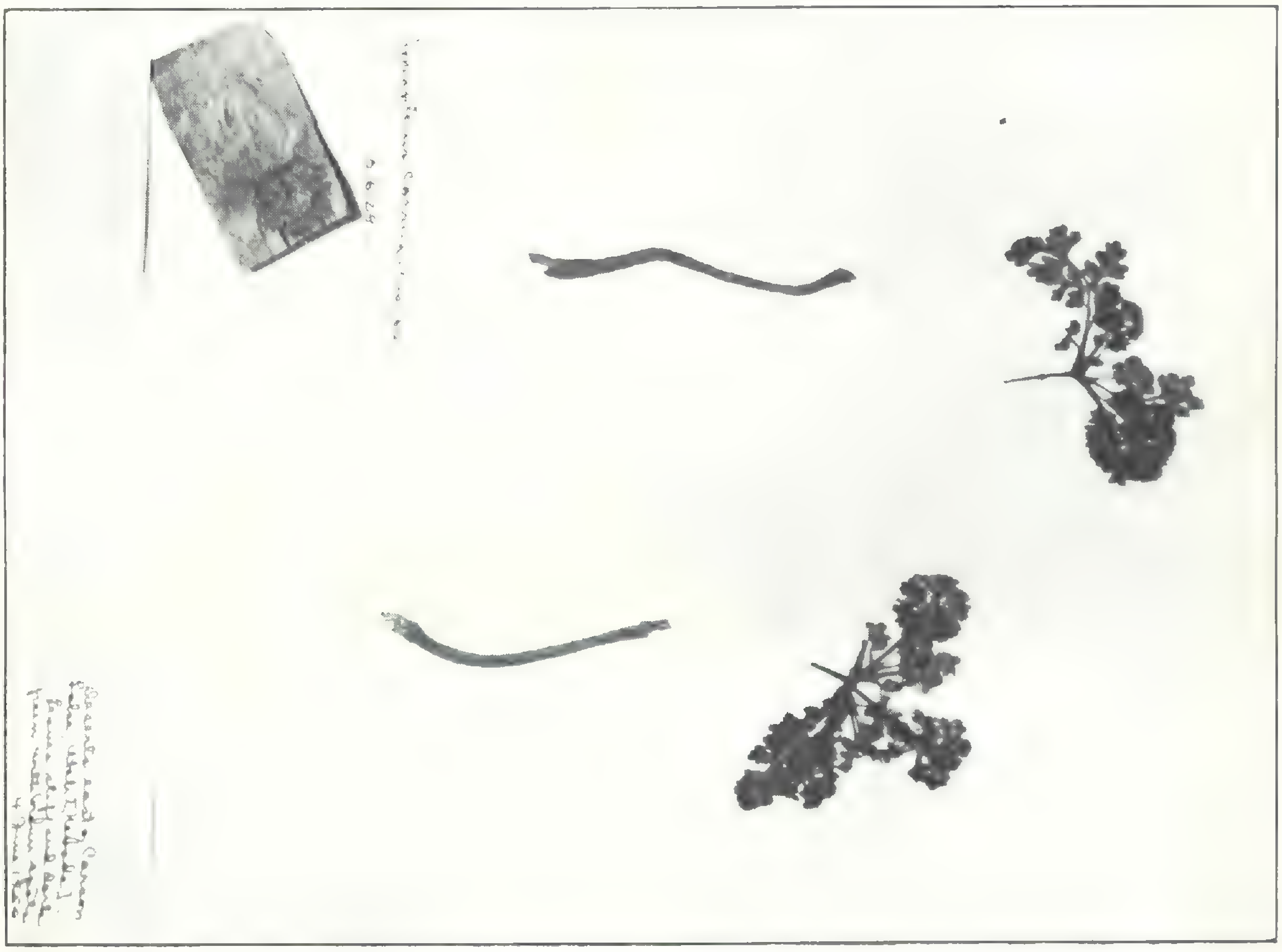

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

PLATE 50

Fig. 1. *Cymopterus acaulis* (Pursh) Raf. From a photograph of the type specimen, *Bradbury*, in the Kew Herbarium.

Fig. 2. *Cymopterus acaulis* (Pursh) Raf. From authentic material, *Nuttall*, in the Herbarium of the Academy of Natural Sciences, Philadelphia.

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MATHIAS—STUDIES IN UMBELLIFERAE

Explanation of Plate

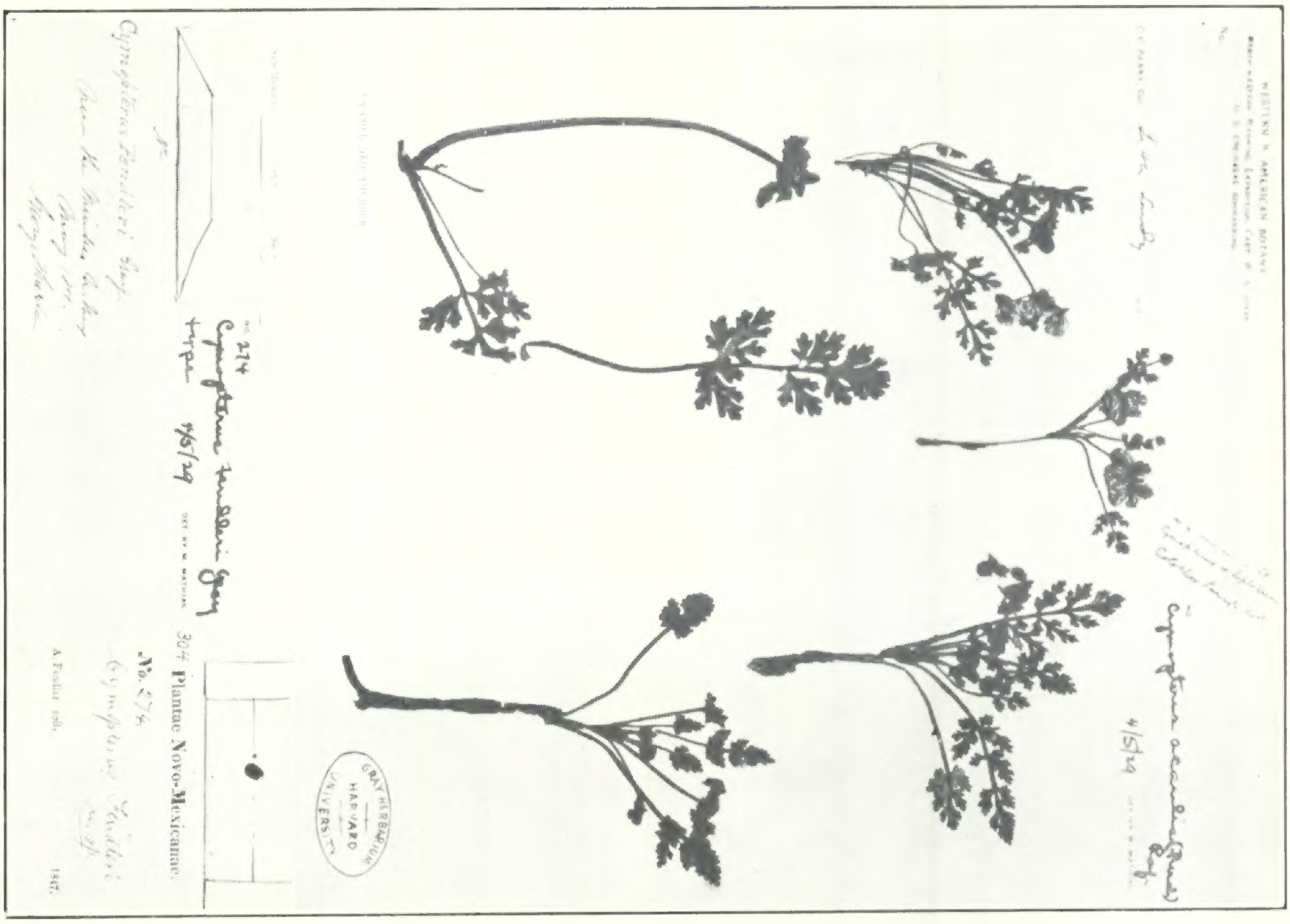
PLATE 51

Fig. 1. *Cymopterus Fendleri* Gray. From the type specimen, *Fendler 274*, and *Thurber*, in the Gray Herbarium of Harvard University.

Cymopterus acaulis (Pursh) Raf. From typical material, *Parry*, in the Gray Herbarium of Harvard University.

Fig. 2. *Cymopterus Fendleri* Gray. From typical material, *Kammerer 47*, in the Missouri Botanical Garden Herbarium.

These two specimens, *Fendler 276* and *Kammerer 47*, illustrate the extremes of variation in the species *C. Fendleri*.



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MATHIAS—STUDIES IN UMBELLIFERAE

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